NUCLEAR SCIENCE ABSTRACTS

Volume 9 September 15, 1955 No. 17

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NUCLEAR SCIENCE ABSTRACTS

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GENERAL

ATOMIC POWER

5568

PROBLEMS OF NUCLEAR POWER. I. THE REMOVAL OF HEAT FROM A NUCLEAR REACTOR. E. W. Titterton (Australian National Univ., Canberra). Atomics 6, 155-7, 182 (1955) June.

BIOLOGY AND MEDICINE

5569 UCRL-2993

California. Univ., Berkeley. Radiation Lab.

THE EFFECT OF THIOCTIC ACID ON THE QUANTUM EFFICIENCY OF THE HILL REACTION IN INTERMITTENT LIGHT. Dan F. Bradley and M. Calvin. May 20, 1955. 15p. Contract W-7405-eng-48.

The yield of oxygen per flash has been measured in Scenedesmus in flashing light. At dark intervals between flashes of 0.05 second the yield per flash is limited by the concentrations of both quinone and thioctic acid in the medium. When the dark interval is lengthened to 0.2 second these limitations disappear and are replaced by light limitation. The yield per flash under these latter conditions is nearly equal to the total amount of thioctic acid in the plant (on a molar basis), which is consistent with the proposal that thioctic acid is participating in the quantum conversion process in photosynthesis, provided that the life time for thermal decay of the photochemically active state (of chlorophyll) is at least of the order of 0.2 second in vivo. This, together with existing data, leads to the suggestion of two distinct physical stages in the conversion of the photon energy into chemical potential, only the second of which may involve thioctic acid. (auth)

RADIATION EFFECTS

5570 AMRL-170

Army Medical Research Lab., Fort Knox, Ky.

THE EFFECT OF INJURY ON EHRLICH TUMOR CELLS. (With Review and Bibliography). D. W. King, S. R. Paulson, N. C. Hannaford, and N. L. Puckett. May 8, 1955. 153p.

The death of control, irradiated, and Salyrgan treated Ehrlich tumor cells was observed over a period of 6 to 24 hours. Protein loss, DNA content, mitotic index, respiration, lactic acid production, dehydrogenase; cell size, sodium and potassium content, entrance of trypan blue, and response to x irradiation, were measured using appropriate techniques. The process of mitosis was found to be most susceptible to injury. The discussion includes a comprehensive review. (auth)

5571 UCRL-3013

California. Univ., Berkeley. Radiation Lab.

MEDICAL AND HEALTH PHYSICS QUARTERLY REPORT [FOR] JANUARY, FEBRUARY, MARCH 1955. Apr. 25, 1955. 61p. Contract W-7405-eng-48.

Progress is reported in the following studies: the tissue distribution and radiation effects of various doses of I^{131} in rats; the preparation of At^{211}; the tissue distribution and toxic effects of At^{211} in rats and monkeys; the care of laboratory monkeys; the design of an in vivo holder and scintillation counting apparatus for radioassays over the thyroid region of rats; the chemical state of At^{211} in the thyroid glands of normal and propyl-thiouracil-treated rats; the preparation of radioautographs following administration of At^{211} and I^{131}; the effects of a body burden from birth of Sr^{90} on the blood count and weight of an infant monkey; the indirect action of radiation in dilute formic acid solutions; the chromatographic separation and quantitative determination of carbonyls by colorimetric methods; determination of the radical pair yield for 35-Mev helium ions in water; the radiation chemistry of aqueous-organic systems; and routine monitoring activities. (For preceding period see UCRL-2881.) (C.H.)

5572 UR-388

Rochester, N. Y. Univ. Atomic Energy Project.

STUDIES OF FLASH BURNS: THE INFLUENCE OF TRANSMITTANCE OF FABRICS ON PROTECTIVITY. G. Mixter, Jr. and L. J. Krolak. May 20, 1955. 14p. Contract W-7401-eng-49.

The spectral transmittance of certain fabrics has been studied and the specific transmittance by them to the 24 in. carbon arc output has been calculated. A method is proposed of correcting, for the transmittance parameter, previously published predictions of the median effective exposure for porcine skin under cotton fabrics (based on exposure time, reflectance, and fabric weight). The degree of correspondence between these corrected estimates and the observed data is shown. (auth)

5573 USNRDL-TR-44

Naval Radiological Defense Lab., San Francisco.

EFFECTS OF X IRRADIATION ON LIPID METABOLISM. III. DOG SERUM LIPOPROTEINS. W. H. Goldwater and C. Entenman. Apr. 7, 1955. 24p.

Dog-serum lipoprotein patterns have been studied by an ultracentrifugal flotation method which uses a $KBr-D_2O$ medium of density 1.21 g/ml. Fatal doses of x radiation produce a terminal decrease of the dense lipoprotein component, while the lighter fractions increase in concentration. Certain of these concentration changes occur in dogs which ultimately survive doses near the LD_{50}, but some components show minimal or no changes in such animals. Possible contributions of various organic or hormonal factors to these lipoprotein abnormalities are discussed. (auth)

5574

METABOLIC RATE CHANGES FOLLOWING THYROID DESTRUCTION BY AT^{211} AND I^{131} IN THE RAT. R. W. E. Watts (Univ. of California, Berkeley). Proc. Soc. Exptl. Biol. Med. 89, 220-2(1955) June.

The time course of the development of hypothyroidism in rats, as judged by the animals' metabolic rates, following the administration of thyroidectomizing doses of At^{211} and I^{131} has been studied. The metabolic rate decreased abruptly to 74% of the control value between 6 and 8 days after the administration of 0.8 μc of At^{211} per g of body weight. A further decrease to the subsequent steady value (between 65% and 70% of the corresponding values for the control group) had occurred by about 20 days from the date of injection. Slowing of the metabolic rate was first observed between 8 and 12 days after the administration of I^{131} (10 μc per g of body weight). The metabolic rate decreased more slowly in the I^{131}-treated than in the At^{211}-treated animals, but ultimately attained a similar steady value. It is suggested that the differences which have been observed after the administration of At^{211} and I^{131} may be correlated with the different nuclear properties of the 2 isotopes. (auth)

5575

RESILIENCE OF THE FETAL EYE FOLLOWING RADIATION INSULT. Roberts Rugh and Joan Wolff (Columbia Univ., New York). Proc. Soc. Exptl. Biol. Med. 89, 248-53 (1955) June.

5576

INVESTIGATION BY THE USE OF LABELED COMPOUNDS OF X-RAY EFFECTS ON CERTAIN CHARACTERISTICS OF ALBUMIN AND ITS SYNTHESIS. A. M. Kuzin, L. Kh. Eidus, and N. B. Strazhevskaya (Inst. of Biological Physics). Doklady Akad. Nauk S.S.S.R. 102, 267-70(1955) May 11. (In Russian)

Uptake of D$_2$O and C^{14} by roots and stems of growing wheat irradiated with 1000 r of 190-kv x rays was studied. (G.Y.)

5577

USE OF HAPLOID AND DIPLOID EMBRYOS OF HABROBRACON IN THE STUDY OF CELL POISONS. A. M. Clark and W. C. Beiser, Jr. (Brookhaven National Lab., Upton, N. Y.). Science 121, 469-70(1955) Apr. 1.

The differential toxic effects of chemical agents were evaluated using the hatchability of eggs from mated and unmated Habrobracon as the criteria. Data are tabulated on the response of both haploid and diploid embryos to x radiation, methyl bis(β-chloroethyl)amine HCl, ethyl bis(β-chloroethyl)amine HCl, 2,2′-dichloro-diethylamine HCl, 2,2′,2″-trichloro-triethylamine HCl, sodium azide, and potassium cyanide. (C.H.)

5578

THE RESPONSE OF THE I^{131}-TREATED THYROID GLAND TO THYROTROPIC HORMONE. Jorge M. Martin and John B. Stanbury (Harvard Medical School and Massachusetts General Hospital, Boston). J. Clin. Endocrinol. and Metabolism 15, 811-17(1955) July.

The effect of thyrotropic hormone on the thyroidal uptake of I^{131} and the serum concentration of protein-bound iodine has been observed in 12 patients previously treated with I^{131} for hyperthyroidism and in 6 subjects in the euthyroid state. The thyroid glands of some of the I^{131}-treated patients responded to the administration of thyrotropin, and some failed to do so. The glands of all control subjects responded. The suggestion is offered that the glands which failed to respond to thyrotropin were already working at or near maximum capacity, and consequently were unable to respond to further thyrotropin stimulation. (auth)

5579

EFFECTS OF FASTING AND X-IRRADIATION ON OXYGEN POISONING IN MICE. Daniel L. Gilbert, Rebeca Gerschman, and Wallace O. Fenn (Univ. of Rochester School of Medicine and Dentistry, New York). Am. J. Physiol. 181, 272-4(1955) May.

Previous fasting of mice for 18, 30, 48, 72 and 84 hours increased the survival time of mice exposed to 6 atm. of oxygen. Mice which were irradiated (8800 r) and mice which were both irradiated and fasted from the onset of irradiation, had about the same survival time in oxygen as mice which were only fasted. Therefore it appears that the protective effect of previous irradiation against oxygen poisoning can be attributed to the anorexia resulting from irradiation. (auth)

5580

AFTER-EFFECTS OF X-IRRADIATION AND PHENYLHYDRAZINE ON THE HEMOGLOBIN, SERUM IRON AND RETICULOCYTES OF RATS. Alfred Chanutin and Elizabeth L. Word (Univ. of Virginia School of Medicine, Charlottesville). Am. J. Physiol. 181, 275-9(1955) May.

The effect of delayed phenylhydrazine administration after total-body x irradiation and delayed total-body x irradiation after phenylhydrazine injection on the serum iron concentration, hemoglobin concentration and reticulocyte counts of rats has been investigated. In both groups, a marked anemia and hyperferremia is observed during the first 5 days subsequent to the final treatment. The results are compatible with the concept that substances formed by ionizing irradiation alone or by phenylhydrazine alone persist in the organism in a comparatively inactive form for an appreciable period. Phenylhydrazine is capable of effectively stimulating bone marrow activity, as judged by blood reticulocyte counts, of animals previously exposed to total-body x irradiation. (auth)

RADIATION HAZARDS AND PROTECTION

5581

PROTECTIVE EFFECT OF SPLEEN SHIELDING ON SUSCEPTIBILITY OF IRRADIATED MICE TO ESCHERICHIA COLI. I. L. Shechmeister, W. H. Paris, F. T. Krause, L. J. Paulissen, and R. Yunker (Washington Univ., St. Louis, Mo.). Proc. Soc. Exptl. Biol. Med. 89, 228-30(1955) June.

Shielding of spleen in mice during irradiation protected them from subsequent infection with E. coli. Sixty-six per cent of the dying irradiated-infected animals succumbed within 48 hours, while only 18% of the sham-shielded-irradiated-infected animals succumbed within this time. The possible role of toxemia in experimental infection of irradiated animals is discussed. (auth)

5582

PROTECTIVE EFFECT OF S,β-AMINOETHYLISOTHIURONIUM·Br·HBr AND RELATED COMPOUNDS AGAINST X-RADIATION DEATH IN MICE. David G. Doherty and W. T. Burnett, Jr. (Oak Ridge National Lab., Tenn.). Proc. Soc. Exptl. Biol. Med. 89, 312-14(1955) June.

Replacement of the sulfhydryl group of β-mercaptoethylamine with the isothiuronium group yields a compound (AET) with increased protective activity and greater chemical stability. A free amino group beta or gamma to the sulfhydryl or isothiuronium group is necessary for protective activity. In the aminoisothiuronium series, the carbon chain can be lengthened by one carbon atom without the loss of protective activity. S,β-aminoethylisothiuronium·Br·HBr provides effective protection against radiation injury at dose levels considerably less than the dose required to produce acute toxic effects. (auth)

TOXICOLOGY STUDIES

5583 UR-393
Rochester, N. Y. Univ. Atomic Energy Project.
THE LONG TERM RETENTION AND DISTRIBUTION OF POLONIUM^{210} IN THE RAT. J. N. Stannard. Apr. 30, 1955. 31p. Contract W-7401-eng-49.

Retention and tissue distribution data are presented from 76 rats receiving single intravenous doses of polonium chloride and maintained from 1 to 445 days after injection. (auth)

5584 UR-395
Rochester, N. Y. Univ. Atomic Energy Project.
THE EFFECTS OF A MAINTAINED BODY BURDEN OF POLONIUM IN THE RAT. III. MORTALITY, LIFE SPAN, AND GROWTH. J. N. Stannard, H. A. Blair, and R. C. Baxter. May 18, 1955. 33p. Contract W-7401-eng-49.

The long term effects of a maintained body burden of polonium^{210} in the rat are described. A total of 483 Wistar-Rochester rats were maintained on a monthly intravenous injection schedule from early maturity throughout life and comparison made with animals receiving a single intravenous injection. The four dosage levels used were 0.023, 0.1, 0.3 and 1.5 μc/kg/month and the body burdens maintained, after equilibrium had been established, were approximately 0.05, 0.23, 0.60, and 2.4μc/kg. Results are summarized. (auth)

5585

INHIBITION OF SALIVARY AMYLASE BY URANIUM. Leon H. Schneyer (Univ. of Alabama School of Dentistry and Medical Coll., Birmingham). Arch. Biochem. Biophys. 56, 500-6(1955) June.

Uranium nitrate, an inhibitor which appears to affect selected enzyme systems by a reversible combination at electronegative groups, inhibits salivary amylase activity completely in a concentration of 10^{-3} M. The inhibition is not affected by doubling enzyme concentration but is reduced by increasing substrate concentration or by the introduction of organic α-OH dicarboxylic acids. (auth)

TRACER APPLICATIONS

5586 UCRL-2885
California. Univ., Berkeley. Radiation Lab.
STUDIES ON THE CARBOXYLATION REACTION OF PHOTOSYNTHESIS. H. L. Kornberg, J. R. Quayle, and M. Calvin. May 19, 1955. 23p. Contract W-7405-eng-48.

Studies have been made on the carboxylation of ribulose-1, 5-diphosphate by cell-free extracts of Chlorella. This reaction has been shown to be independent of light. The action of various cofactors and inhibitors has been studied, and a scheme of reactions catalyzed by the extract, which is consistent with the data, is presented. (auth)

5587 UCRL-2942
California. Univ., Berkeley. Radiation Lab.
RADIOISOTOPES IN HEMATOLOGY. Rollin K. McCombs, and John H. Lawrence. Mar. 29, 1955. 27p. Contract W-7405-eng-48.

A summary is presented on hematological studies in which radioisotopes were employed as tracers or in therapy of various hematological disorders. Data were obtained from a review of the literature since 1950. (C.H.)

CHEMISTRY

5588 AECU-3041
RAND Corp., Santa Monica, Calif.
EQUATION OF STATE OF WATER. A. K. Latter and R. Latter. May 23, 1955. 5p. For Univ. of Calif. Radiation Lab., [Berkeley. Contract W-7405-eng-48], Subcontract SC-64. (RM-1492-AEC)

The Fermi-Thomas model, generalized to apply to mixtures, has been used to obain the equation of state of water up to pressures of 10,000 megabars and temperatures of several thousand ev. Calculations are presented for the thermal, caloric, and adiabatic equations of state. (auth)

5589 KAPL-1067
Knolls Atomic Power Lab., Schenectady, N. Y.
THE REACTION BETWEEN LITHIUM AND HYDROGEN AT TEMPERATURES BETWEEN 29°C–250°C. Edwin E. Swain, Jr. and Frederick K. Heumann. Mar. 1, 1954. Decl. May 9, 1955. 32p. Contract W-31-109-Eng-52.

The preparation of lithium hydride by the direct reaction of the elements at temperatures below the melting point of lithium has proved to be possible, but several days are required to complete the reaction if the lithium sample is larger than 0.5 g. The reaction appears to be first order with respect to pressure in the initial stages, but the diffusion of hydrogen through the lithium hydride layer formed soon decreases the initial rate and becomes the limiting factor. The finely divided lithium, which is necessary for the reaction at moderate temperatures, can be prepared by dissolution of the metal in ammonia at low temperatures. Distillation of the ammonia from this solution leaves the lithium in a finely divided state and distributed over most of the surface of the vessel. Nitrogen contamination from the dissolution step amounts to slightly less than 1% if ample time is allowed to pump off the last traces of ammonia. (auth)

5590 ORNL-1799
Oak Ridge National Lab., Tenn.
FLAMMABILITY OF SODIUM ALLOYS AT HIGH TEMPERATURES. G. P. Smith, M. E. Steidlitz, and L. L. Hall. July 6, 1955. 5p. Contract W-7405-eng-26.

This report gives data on the flammability in air of jets of sodium alloys at temperatures from 600 to 800°C. Most sodium alloys are highly reactive under these conditions, but it has been found that sodium alloys containing mercury or bismuth are nonflammable over certain ranges of composition and temperature. (auth)

5591 AEC-tr-2182
DIFFUSION OF HYDROGEN IN QUARTZ. V. Kondrat'ev (Kondratyev). Translated from Zhur. Eksptl'. i Teoret. Fiz. 13, 59-64(1943). 9p.

The rate of diffusion of H_2 in quartz at temperatures up to 1025°C and pressures of the order of 0.1 to 1 atm. has been measured. It is shown that, in the given temperature interval, hydrogen diffuses in quartz practically in the form of the molecule, H_2. (auth)

5592

ISOTOPIC EXCHANGE METHOD FOR MEASURING THE PRESSURE OF SATURATED VAPORS. An. N. Nesmeyanov, V. I. Lozgachev, and N. F. Lebedev (Moscow State Univ.). Doklady Akad. Nauk S.S.S.R. 102, 307-10(1955) May 11. (In Russian)

5593

THE ORDER AND MECHANISM OF THE ISOTOPIC EXCHANGE REACTIONS OF SECONDARY AND TERTIARY ALKYL BROMIDES IN ANHYDROUS ACETONE. L. J. le Roux and E. R. Swart (Univ. of Pretoria, South Africa). J. Chem. Soc., 1475-9(1955) May.

Isotopic exchange reactions between radioactive lithium bromide and isopropyl bromide and tert-butyl bromide were studied in anhydrous acetone over a range of ionic concentrations. An equation was found according to which the first- and second-order rate constants for these reactions were determined. The first-order contribution to the exchange reaction of isopropyl bromide is too small to be accurately determined. For the reaction of tert-butyl bromide at 40° and a lithium bromide concentration of 0·01 N, the first and the second-order reaction contribute about equally to the exchange rate. The frequency factors and Arrhenius energies of activation for these reactions were determined. (auth)

5594

THE EFFECT OF CYANIDE ON THE RATE OF THE THALLOUS-THALLIC EXCHANGE REACTION. Eduardo Penna-Franca and Richard W. Dodson (Brookhaven National Lab., Upton, N. Y.). J. Am. Chem. Soc. 77, 1651-3(1955) May 5.

The rates of the $Tl^{+}-Tl^{3+}$ exchange in the presence of varying concentrations of CN^{-} have been determined. Small amounts of CN^{-} diminish the rate. After a minimum was observed the rate of the exchange reaction increased with increasing $[CN^{-}]$. An interpretation which is based on thallium–cyanide complex formation is given for the observed rates of exchange. (C.W.H.)

5595

THE INTERACTION OF CHROMIUM(III) AND CHROMIUM (VI) IN ACIDIC SOLUTION. Edward L. King and John A. Neptune (Univ. of Wisconsin, Madison). J. Am. Chem. Soc. 77, 3186-9(1955) June 20.

Experimental results indicate that there are rapidly formed in acidic solutions of Cr^{3+} and Cr^{6+}, and the species $CrCrO_4^{+}$ and $CrCrO_4H^{2+}$. It is postulated that these complexes are of the "inner-sphere" type, the $Cr^{6+}-O$ bond being broken and formed in the reaction. (C.W.H.)

5596

KINETICS OF THE REDUCTION OF FERRIC ION BY HYDROQUINONE IN THE PRESENCE OF 1,10-PHENANTHROLINE. Frederick R. Duke and Frank R. Parchen (Iowa State Coll., Ames.). J. Am. Chem. Soc. 77, 3198-9 (1955) June 20.

The reduction of ferric ion by hydroquinone in the presence of 1,10-phenanthroline is found to proceed by direct complexing of the hydroquinone by the ferric ion in competition with the 1,10-phenanthroline. This mechanism is in contrast to that generally believed to be operative when the iron–1,10-phenanthroline complex acts as indicator, there being no displacement of 1,10-phenanthroline in the latter process. (auth)

5597

THE VAPOR PRESSURE OF POLONIUM. LeRoy S. Brooks (Mound Lab., Miamisburg, Ohio). J. Am. Chem. Soc. 77, 3211(1955) June 20.

The vapor pressures of polonium between 0.3 and 90 mm with corresponding temperatures of 438° and 745°C have been measured. The boiling point and the heat of vaporization were calculated from these measurements. (C.W.H.)

ANALYTICAL PROCEDURES

5598 BNL-2343

Brookhaven National Lab., Upton, N. Y.

HYDROXYLYSINE. Donald D. Van Slyke. [1955]. 17p.

Hydroxylysine is a constant constituent of animal collagen. It has not been demonstrated in significant amounts in any other type of protein. In press juice from embryonic calf muscle chromatographic studies indicate the presence of a phosphoric acid ester of hydroxylysine, but in collagen the hydroxylysine is not phosphorylated. The nature of the biologically essential role of hydroxylysine in collagen remains to be ascertained. (auth)

5599 CI/R-72

Gt. Brit. Ministry of Supply. Chemical Inspectorate, London.

THE DETERMINATION OF SUB-MICRO-GRAM QUANTITIES OF MANGANESE USING LEUCO MALACHITE GREEN. J. A. Adam. Sept. 1952. 17p. (WAD/R-104; AD-11550)

A colorimetric method is described for the determination of Mn using tetramethyldiaminotriphenylmethane. The Mn is oxidized to permanganate by potassium periodate, the permanganate subsequently oxidizing the leuco-base to malachite green, which is then determined absorptiometrically. (auth)

5600

THE PHOTOMETRIC DETERMINATION OF IRON IN ALUMINIUM ALLOYS. H. Jackson, R. E. Bailey, and L. H. Williams (British Aluminium Co., Ltd., Gerrards Cross, Bucks, England). Metallurgia 51, 309-11(1955) June.

A photometric method is described for the determination of iron in aluminum alloys using o-phenanthroline. The method is applicable to the determination of iron in pure aluminum and all types of alloys, and is free from interference from any of the usual alloying constituents. It can also be used for the analysis of hardeners. (auth)

5601

CHEMISTRY OF THORIUM. II. VOLUMETRIC DETERMINATION OF THORIUM. N. K. Dutt and A. K. Chowdhury (Univ. Coll. of Science, Calcutta, India). Anal. Chim. Acta 12 515-18(1955) June.

A volumetric method for the determination of thorium is described. Thorium is precipitated with m-nitrobenzoic acid; thorium m-nitrobenzoate is dissolved in H_2SO_4 and titrated with $TiCl_3$ to determine the NO_2 group which gives the amount of Th directly. (auth)

5602

THE RARE EARTHS. A POLAROGRAPHIC STUDY. A. Purushottam and Bh. S. V Raghava Rao (Andhra Univ., Waltair, India). Anal. Chim. Acta 12, 589-99(1955) June.

From a study of the polarograms of chlorides of lanthanum, praseodymium, neodymium, samarium, gadolinium, dysprosium, and yttrium in 0.1N lithium chloride together with 0.01% gelatin as maximum suppressor, it has been shown that the reduction proceeds in two stages: $M^{3+} + e \rightleftharpoons M^{2+}$ and $M^{2+} + 2e \rightleftharpoons M$. In the case of the less basic elements, anomalies in the heights of the second steps have been observed and these anomalies have been qualitatively explained on the basis of disturbing electrode reactions. The half-wave potentials for each step have been listed. (auth)

5603

QUANTITATIVE ANALYSIS FOR THORIUM BY X-RAY FLUORESCENCE. Alan G. King and Pauline Dunton (U. S.

Geological Survey, Denver, Colo.). Science 122, 72(1955) July 8.

A method is described in which fluorescent x-ray analysis is applied in the quantitative assay of samples of rocks, minerals, and ores for Th. (C.H.)

5604

DETERMINATION OF RADIOACTIVE STRONTIUM AND BARIUM IN WATER. Richard B. Hahn and Conrad P. Straub. J. Am. Water Works Assoc. 47, 335-40(1955) Apr.

A procedure is given for the determination of low concentrations of radioactive strontium (to about 4×10^{-8} μc per milliliter) and barium (to about 10^{-7} μc per milliliter). The method was tested on various natural and waste waters. A precision of about 10 per cent was obtained. As the method does not distinguish between the various isotopes of strontium or barium — for example between Sr^{89} and Sr^{90} — decay and absorption analyses would be required for this information. (auth)

5605

SPECTROPHOTOMETRIC DETERMINATION OF CERIUM AFTER OXIDATION TO CERIUM(IV) WITH LEAD DIOXIDE. Louis Gordon and A. M. Feibush (Syracuse Univ., N. Y.). Anal. Chem. 27, 1050-1(1955) July.

Ce^{3+} is oxidized to Ce^{4+} with PbO_2 in sulfuric acid media. The Ce^{4+} is then made to react with excess Fe^{2+} immediately after excess oxidant is removed by filtration. The residual Fe^{2+} is determined spectrophotometrically with o-phenanthroline, and compared to a Ce-free blank. (auth)

5606

FLAME SPECTROPHOTOMETRIC DETERMINATION OF IRON IN SILICEOUS MATERIALS. John A. Dean and J. C. Burger, Jr. (Univ. of Tennessee, Knoxville). Anal. Chem. 27, 1052-5(1955) July.

The application of the flame spectrophotometer to the rapid, routine determination of Fe in siliceous materials is described. The arc emission line at 386.0 mμ was used to measure the Fe radiation. Interfering ions can be corrected for by using an internal standard. The optimum concentration range for Fe is between 25 and 200 ppm. (auth)

5607

THE CHEMISTRY OF THORIUM. SPECTROPHOTOMETRIC DETERMINATION OF THORIUM AS THE NAPHTHAZARIN COMPLEX. Therald Moeller and Melvin Tecotzky (Univ. of Illinois, Urbana). Anal. Chem. 27, 1056-8(1955) July.

A spectrophotometric method for Th determination based upon complex formation with naphthazarin is presented. Thorium must be separated from the interfering rare earth ions before this method can be used. (C.W.H.)

5608

DETERMINATION OF THORIUM AND OF RARE EARTH ELEMENTS IN CERIUM EARTH MINERALS AND ORES. M. K. Carron, D. L. Skinner, and R. E. Stevens (Geological Survey, Washington, D. C.). Anal. Chem. 27, 1058-61(1955) July.

A gravimetric method is outlined for the determination of Th and rare-earth metals in cerium earth minerals. The thorium and rare-earth oxalates are precipitated by adding a solution of oxalic acid in methanol to the mineral solution, with Ca acting as a carrier. The calcium is removed by precipitating the hydroxides of Th and rare earths at room temperature with NH_4OH at pH >10. Thorium is separated as the sebacate at pH = 2.5 and the rare earths are precipitated with ammonium sebacate at pH = 9. (C.W.H.)

5609

DETERMINATION OF OXYGEN IN METALS WITHOUT HIGH VACUUM BY CAPILLARY TRAP METHOD. William G. Smiley (Los Alamos Scientific Lab., N. Mex.). Anal. Chem. 27, 1098-1102(1955) July.

A capillary trap method for the determination of O_2 in metals is described. The metallic sample is dropped into molten platinum in a graphite crucible. Any O_2 in the sample reacts to form CO which is swept out by a stream of A at atmospheric pressure. A modified form of Schütze's reagent oxidizes the CO to CO_2, which is condensed in a capillary trap and measured with a capillary manometer. The apparatus is sensitive to 0.3γ of O_2. Examples of the application of this method to several metals are given. (auth)

5610

PREPARATION AND STANDARDIZATION OF PERCHLORATOCERIC ACID SOLUTIONS IN PERCHLORIC ACID. G. Frederick Smith (Univ. of Illinois, Urbana). Anal. Chem. 27, 1142-4(1955) July.

Laboratory directions for the preparation of Ce^{4+} solutions in perchloric acid as supporting electrolyte are given, including directions for standardization. (auth)

GRAPHITE

5611

X-RAY MEASUREMENTS ON LOW-TEMPERATURE NEUTRON-IRRADIATED GRAPHITE. David T. Keating (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 98, 1859-60(1955) June 15.

Natural graphite compacted into highly oriented briquettes was irradiated at −196°C in the Brookhaven reactor. X-ray-diffraction measurements were made at this temperature. Preliminary evidence indicates that damage to graphite is greater at low temperatures. (B.J.H.)

MOLECULAR STRUCTURE

5612

TRAPPED ATOMS AND RADICALS IN RIGID SOLVENTS. I. Norman and G. Porter (Univ. of Cambridge, England). Proc. Roy. Soc. (London) A230, 399-414(1955) June 21.

A number of very reactive radicals and atoms prepared by photolysis in rigid hydrocarbon glasses at the temperature of liquid nitrogen have been detected by their absorption spectra. Thus ethyl iodide dissociates to iodine atoms which only recombine to give I_2 when the glass is softened. Similarly CS_2 and ClO_2 give CS and ClO which can be detected spectroscopically in the frozen glass. Toluene and other benzyl derivatives yield the benzyl radical, and the spectra of a number of similar unstable aromatic radicals have been recorded for the first time. Most of these radicals have lifetimes of less than 1 ms at comparable concentrations in the gas phase or in ordinary solutions, but have been observed for many hours in the rigid glass. The method should be of general applicability for the study of the primary products of photochemical or radiation chemical processes. (auth)

5613

METAL-AMINE COORDINATION COMPOUNDS. V. THE

RUTHENIUM-2,2′-BIPYRIDINE SYSTEM. Ronald R. Miller, Warren W. Brandt, and Sr. Marina Puke (Purdue Univ., Lafayette, Ind.). J. Am. Chem. Soc. 77, 3178-80(1955) June 20.

Mono- and bis-2,2′-bipyridine–ruthenium(III) complexes have been identified as intermediates in the stepwise formation of the tris-2,2′-bipyridine–ruthenium(II) complex ion. Evidence is presented for a chloro-series of ruthenium-2,2′-bipyridine complexes. Comparisons to the corresponding iron system are made. (auth)

RADIATION CHEMISTRY

5614

THE DECOMPOSITION OF SULFURIC ACID BY COBALT γ-RAYS. C. J. Hochanadel, J. A. Chormley, and T. J. Sworski (Oak Ridge National Lab., Tenn.). J. Am. Chem. Soc. 77, 3215(1955) June 20.

The radiation stability of sulfuric acid in aqueous solutions was determined by measurements of the SO_2 produced from γ-irradiated solutions. Little or no SO_2 could be detected in irradiated solutions containing less than 60% sulfuric acid; in solutions containing more than 60% sulfuric acid, SO_2 was produced at a rate which increased with increasing acid concentration and decreased with increasing dose. (C.W.H.)

RADIATION EFFECTS

5615

STUDIES ON THE ACTION OF X-RAYS ON AQUEOUS SOLUTIONS OF NUCLEIC ACIDS AND SOME NUCLEOTIDES. M. Daniels, G. Scholes, and J. Weiss (Univ. of Durham, Newcastleupon-Tyne, England). Experientia 11, 219-21(1955) June. (In English)

5616

CHANGES IN SILICONE POLYMERIC FLUIDS DUE TO HIGH-ENERGY RADIATION. A. Charlesby (Atomic Energy Research Establishment, Harwell, Berks, England). Proc. Roy. Soc. (London) A230, 120-35(1955) June 7.

When subjected to high-energy radiation, polydimethyl siloxanes can be cross-linked to form insoluble amorphous structures which are transparent and have marked rubber-like properties. Data are given on the relation between molecular weight and bulk viscosity, which is often used to characterize these polymers. The relationship between cross-linking density and radiation dose is deduced from the changes in both solubility and fusibility, and is confirmed by elastic measurements. Unit pile radiation is found to produce cross-linking in about 2.2% of the monomer units. Details are given of the change in solubility and swelling with radiation dose and of the mechanism of cross linking. The energy per cross link is about 32 ev, and is independent of molecular weight. A brief comparison is made with cross-linking in hydrocarbon polymers. (auth)

5617

RADIATION PROTECTION IN COPOLYMERS OF ISOBUTYLENE AND STYRENE. P. Alexander (Royal Cancer Hospital, London) and A. Charlesby (Atomic Energy Research Establishment, Harwell, Berks, England). Proc. Roy. Soc. (London) A230, 136-45(1955) June 7.

The effect of ionizing radiations on copolymers of isobutylene and styrene has been studied. Molecules consisting only of isobutylene units degrade under radiation, whereas styrene polymer cross-links. In the copolymer the styrene units offer protection against radiation to the neighbouring isobutylene units. An estimate is given for the extent of this protection. On irradiation the copolymer at first degrades to an extent which depends on the percentage of styrene, then it cross-links partially into a gel. Even for copolymers containing 80% of styrene, protection is only partial, and after high radiation doses specimens separate into a gel and a sol fraction. It is not possible to cross-link such copolymers sufficiently to produce a completely insoluble material. Chemical analysis of the irradiated copolymer shows that the separate units are distributed approximately at random throughout the material, and do not occur in large blocks high in styrene or isobutylene. (auth)

RARE EARTHS AND RARE-EARTH COMPOUNDS

5618 ISC-604

Ames Lab., Ames, Iowa.

THE STABILITY OF THE RARE EARTH COMPLEXES WITH N-HYDROXYETHYLETHYLENEDIAMINETRIACETIC ACID. F. H. Spedding, J. E. Powell, and E. J. Wheelwright. May 19, 1955. 20p. Contract W-7405-eng-82.

The stability constants of the complexes formed between the rare earth metal ions and the anion of N-hydroxyethylethylenediaminetriacetic acid, abbreviated HEDTA, have been measured at a temperature of 25°C and an ionic strength of $\mu = 0.1$ by two independent methods. In the first method, the rare earth-HEDTA stability constants were calculated from measurements of the equilibrium constants of reactions involving competition between HEDTA and a polyamine chelating agent, triaminotriethylamine, for the rare earth ions. The equilibrium constants were calculated from pH measurements of the various reaction mixtures. The second method involved the polarographic measurement of the amount of free copper ions liberated when equal molar quantities of the copper II-HEDTA complex and rare earth ions are mixed together. (auth)

5619 AEC-tr-2180

ON THE CRYSTALLINE STRUCTURE OF THE COMPOUNDS OF RARE EARTHS AND METALLOIDS OF GROUP V—PHOSPHIDES OF LANTHANUM, CERIUM, AND PRASEODYMIUM. PAPER NO. I. (Sulla Struttura Cristallina Dei Composti Delle Terre Rare Con i Metalloidi Del V Gruppo—Fosfuri Di Lantanio, Cerio e Praseodimio. Nota I). A. Iandelli ad E. Botti. Translated from Atti accad. Lincei, Classe sci. fis., mat. nat. 24, 459-64(1936). 5p.

The preparation of the phosphides of Ce, La, and Pr is described. Analyses of the powder photograms reveal that these compounds have a NaCl-type crystal structure. (C.W.H.)

5620 AEC-tr-2181

ON THE CRYSTALLINE STRUCTURE OF THE COMPOUNDS OF RARE EARTHS AND METALLOIDS OF GROUP V—1:1 COMPOUNDS WITH BISMUTH. PAPER V. (Sulla Struttura Cristallina Dei Composti Delle Terre Rare Con i Metalloidi Del V Gruppo—Composti 1:1 Col Bismuto. Nota V). A. Iandelli and E. Botti. Translated from Atti accad. Lincei, Classe sci. fis., mat. nat. 26, 233-8(1937). 5p.

The preparation of the bismuthides of La, Ce, and Pr is described. Analyses of the powder photograms indicate that these compounds have a NaCl-type crystal structure.

Crystalline properties of the compounds of La, Ce, and Pr with the metalloids of Group V are discussed. (C.W.H.)

SEPARATION PROCEDURES

5621 ISC-611

Ames Lab., Ames, Iowa.

A LABORATORY METHOD FOR SEPARATING NITROGEN ISOTOPES BY ION-EXCHANGE. F. H. Spedding and J. E. Powell. June 9, 1955. 33p. Contract W-7405-eng-82.

Various aspects of the separation of N^{15} and N^{14} isotopes from each other by an ion-exchange process have been discussed. A number of experiments have been performed to establish the feasibility of using the process and to check the countercurrent theory of separation which has been developed. The separation factor for the exchange of N^{15} and N^{14} between a solution of dilute ammonium hydroxide and the ammonium form of Dowex 50-X12 was measured and found to be 1.0257 ± 0.0002. It was shown that an adsorbed band of ammonium ion must be eluted about 39 times its length in order to achieve separation of the isotopes. A method of continuous operation using a series of ion-exchange beds has been described and factors which influence the HETP at a steady state have been investigated. (auth)

5622 NP-5673

Dow Chemical Co. [Western Div., Pittsburg, Calif.] and Stanford Research Inst., Calif.

TABLES FOR PREDICTING THE PERFORMANCE OF FIXED BED ION EXCHANGE AND SIMILAR MASS TRANSFER PROCESSES. Ascher Opler and Nevin K. Hiester. 1954. 113p.

Generalized concentration history equations have been formulated for mass-transfer processes including ion exchange and heat transfer. Values for the dimensionless relations found in the equations are listed in the tables. (C.W.H.)

5623 TID-5146

Pennsylvania. Univ., Philadelphia.

REPORT ON VAPOR-LIQUID EQUILIBRIA OF NITRIC ACID SOLUTIONS CONTAINING CHLORIDE ION. P. F. Hagerty and A. N. Hixon. [1953?]. Decl. Jan. 7, 1954. 21p. For Catalytic Construction Co. [Contract AT(30-1)-1311, Sub-] Contract AEC-3000-5131.

The extent of chlorine volatilization in the vaporization of raffinate solutions containing free nitric acid and metal nitrates was investigated. Vapor-liquid equilibrum determinations were carried out on nitric acid solutions to which was added HCl. It was found that MnO_2 is not sufficiently soluble in nitric acid to oxidize the chloride present in the raffinate solutions. (C.W.H.)

SPECTROSCOPY

5624

FLUORESCENT CENTRES IN URANIUM-ACTIVATED SODIUM FLUORIDE. W. A. Runciman (Atomic Energy Research Establishment, Harwell, Berks, England). Nature 175, 1082(1955) June 18.

A significant change in the line intensities of the spectra when Ca, as the chloride, is added to uranium-activated NaF has been observed. It is suggested that this change may be due to a pairing of the U and Ca ions. (C.W.H.)

SYNTHESES

5625 LA-1890

Los Alamos Scientific Lab., N. Mex.

THE PREPARATION AND CRYSTAL STRUCTURES OF LEAD AND MERCURY POLONIDES. Willard G. Witteman, Angelo L. Giorgi, and Dwayne T. Vier. Mar. 1955. 12p. Contract W-7405-eng-36.

Compounds of polonium with lead and mercury were prepared by a microcapillary technique. The composition and crystal structure of these intermetallic compounds of polonium were determined from x-ray powder diffraction patterns. The results obtained for the lead and mercury compounds are:

Compound	Reaction Temp., °C	Crystal Form	Type	a_0 (A)	Density, gm/cc
PbPo	350	cubic	NaCl	6.590 ± 0.003	9.6
HgPo	325	cubic	NaCl	6.250 ± 0.003	11.1

(auth)

5626 NP-5696

Southwest Research Inst., San Antonio.

POLYNUCLEAR AROMATIC COMPOUNDS FOR HIGH TEMPERATURE LUBRICANTS. QUARTERLY REPORT NO. 2 [FOR] MARCH 1, 1955–JUNE 1, 1955. TECHNICAL REPORT NO. 11. Charles F. Raley, Jr. 25p. Contract AF-33(616)-276.

The program of improving the low-temperature fluidity of thermally stable phosphate esters without excessive sacrifice of high-temperature properties was continued. The m-trifluoromethylphenyl group appears to confer fluidity, but with excessive volatility. The technique of forming physical-chemical phosphate mixtures by the reaction of mixed phenols such as m-chlorophenol, o-chlorophenol or phenol with phosphorus oxychloride seems to offer promise of suitable fluidity without excessive volatility. Two attempts to prepare a silicon—phosphorous compound, diphenyl triphenylsilyl phosphate, were unsuccessful. (For preceding period see NP-5598.) (auth)

TRANSURANIC ELEMENTS AND COMPOUNDS

5627 UCRL-3037

California. Univ., Berkeley. Radiation Lab.

ISOTOPE SHIFT AND WAVELENGTHS OF THE CURIUM SPECTRUM. John G. Conway and Ralph D. McLaughlin. June 15, 1955. 13p. Contract W-7405-eng-48.

One hundred eighty-two lines of curium were recorded, 148 of which had isotope shift. Both positive and negative shifts were found. The magnitude of the shift ranged up to 0.131 cm^{-1}. (auth)

TRITIUM AND TRITIUM COMPOUNDS

5628

PROCEDURE FOR ROUTINE ASSAY OF TRITIUM IN WATER. C. Gardner Swain, V. P. Kreiter, and William A. Sheppard (Massachusetts Inst. of Tech., Cambridge). Anal. Chem. 27, 1157-9(1955) July.

A precise method for the assay of the tritium content of tritiated water has been developed. The method involves reduction of ca. 1 millimole of the tritiated water to tritiated hydrogen which is transferred to an ionization chamber. The ion current activity of the tritium is measured with a vibrating reed electrometer. Analyses are reproducible to ±2% over a thousandfold activity range, from 10^{-6} to 10^{-9} curies per millimole. (auth)

URANIUM AND URANIUM COMPOUNDS

5629

STABILITY OF COMPLEXES OF URANIUM(IV) WITH CHLORIDE, SULFATE AND THIOCYANATE. R. A. Day, Jr., R. N. Wilhite, and F. D. Hamilton (Emory Univ., Georgia). J. Am. Chem. Soc. 77, 3180-2(1955) June 20.

Values of stability constants of complexes of uranium(IV) with chloride, sulfate, and thiocyanate have been determined at ionic strength 2.0 at 10, 25, and 40°C. The solvent extraction method, using 2-thenoyltrifluoroacetone as a chelating agent, was employed. Values for the changes in free energy, heat content, and entropy at 25°C are reported. (auth)

5630

URANYL OXINATES. A SPECTROPHOTOMETRIC STUDY. K. S. Venkateswarlu and Bh. S. V. Raghava Rao (Andhra Univ., Waltair, India). Anal. Chim. Acta 12, 554-61(1955) June.

From spectrophotometric studies of the 2- and 3-oxinates of uranyl in various non-aqueous solvents it has been shown that the two complexes possess different structures. The change in absorption of oxine in acidic and alkaline solutions has been explained. (auth)

ENGINEERING

5631

IMPROVED GLASS VALVE. S. S. Kirslis and C. Asmanes (Carbide and Carbon Chemicals Co. (K-25), Oak Ridge, Tenn.). Rev. Sci. Instr. 26, 615-16(1955) June.

A glass bellows valve with a silver chloride seat has been designed which combines the advantages of chemical inertness at elevated temperatures, low leak rate, high flow capacity, mechanical strength, and ease of construction. (auth)

5632

VERSATILE GLASS-TO-METAL VACUUM SEAL. O. C. Yonts and H. W. Morgan (Oak Ridge National Lab., Tenn.). Rev. Sci. Instr. 26, 619-20(1955) June.

Several standard diameters of glass tubing which make vacuum-tight seals with available O-rings are listed. Ease of insertion of the tubing without damage to the O-ring is obtained by fire-polishing the tubing to a rounded edge. (L.M.T.)

HEAT TRANSFER AND FLUID FLOW

5633 NACA-RM-E54F11

Lewis Flight Propulsion Lab., Cleveland.

EXPERIMENTAL HEAT-TRANSFER AND FRICTION COEFFICIENTS FOR AIR FLOWING THROUGH STACKS OF PARALLEL FLAT PLATES. Eldon W. Sams and Walter F. Weiland, Jr. [June 14, 1954]. 33p.

Forced-convection heat-transfer and pressure-drop data were obtained for stacks of parallel flat plates of short length-to-effective-diameter ratio. Two such stacks were alined and misalined in the direction of air flow with gap spacings between stacks of $^1/_{32}$, $^1/_8$, and $^1/_4$ in. Data were obtained with heat addition to the downstream stack only over a range of Reynolds number from 15,000 to 80,000 and average surface temperatures of about 680°R. The average and local heat-transfer coefficients were only slightly higher than predicted values from established round tube data. The friction data for both stacks are compared. (NACA abst.)

5634 NP-5697

Lehigh Univ., Bethlehem, Penna. Inst. of Research.

THE INVESTIGATION OF THERMAL AND ELECTRICAL CONDUCTIVITIES OF METALS AT HIGH TEMPERATURES. TECHNICAL REPORT NO. 2. THE TIME-DEPENDENT, THREE-DIMENSIONAL HEAT FLOW PROBLEM IN A TWO-MEDIUM COMPOSITE CYLINDER. Alba D. Craft. May 30, 1955. 27p. Contract DA-36-034-ORD-1475.

A mathematical solution is presented for the time-dependent, three-dimensional heat flow problem in a two-medium composite cylinder. Suggestions are included concerning possible experimental applications in measurements of thermal conductivities of metals. It is concluded that a transient method can be devised from the time-dependent, three-dimensional heat flow solution which will be a considerable improvement over the steady-state technique. (Cf. NP-5452.) (C.H.)

MATERIALS TESTING

5635 NACA-TN-3214

Massachusetts Inst. of Tech., Cambridge.

FUNDAMENTAL STUDY OF EROSION CAUSED BY STEEP PRESSURE WAVES. B. G. Rightmire and J. M. Bonneville. June 1954. 30p.

A fundamental study of erosion caused by steep pressure waves has been carried out. It is believed that the study gives an insight to the possible causes of damage in high-speed sleeve bearings. In particular, the effect on annealed copper surfaces of steep-fronted pressure waves in oil has been studied, the general conclusion being that cavitation of the oil is the probable cause of damage. (auth)

5636 NACA-TN-3334

Lewis Flight Propulsion Lab., Cleveland.

FRICTION OF POSSIBLE SOLID LUBRICANTS WITH VARIOUS CRYSTAL STRUCTURES. Marshall B. Peterson and Robert L. Johnson. [Oct. 12, 1954]. 32p.

A number of solids with CdI_2, $CdCl_2$, and MoS_2 types of layer lattice were tested in a low-speed friction apparatus for lubrication effectiveness. Some solids with these structures performed in a manner similar to MoS_2 in that they did lubricate effectively over extended periods of sliding, namely, CdI_2, $CdCl_2$, and PbI_2, $CoCl_2$, and WS_2; other layer-lattice solids that were effective are HgI_2 and Ag_2SO_4. Not all were effective lubricants. Some low-shear-strength solids that did not have a layer lattice were tested and gave surface protection. Effectiveness as a solid lubricant seemed to be associated with the formation of adherent films on both mating specimens. (auth)

5637 NBS-4109

National Bureau of Standards, Washington, D. C.

SURVEY OF STRESS-STRAIN RECORDERS FOR TESTING MATERIALS. R. R. Bouche and D. R. Tate. May 1955. 35p. Sponsored by ONR; OSR; and AEC under contracts NAonr-21-48 and CS-640-55-9.

The principles of operation, the limitations which determine the use, and the performance characteristics of stress-strain recorders are described. (The stress-strain recorders described include only those which plot simultaneously stress vs. strain.) Detailed information is given on stress-strain recorders used in the testing of metallic materials. However, there is also some information included on stress-strain recorders used for testing other materials. (auth)

5638 NP-5702
Mine Safety Appliances Co., Callery, Penna.
PRELIMINARY REPORT NO. 6 ON THERMAL SHOCK APPARATUS. MEMORANDUM REPORT NO. 40. R. A. Tidball and M. M. Shrut. July 27, 1953. 4p. 1 illus.

PUMPS

5639
AN AUTOMATIC TOEPLER PUMP AND A CIRCULATING PUMP. E. J. Wilson (Atomic Energy Research Establishment, Harwell, Berks, England). Vacuum 3, 287-8(1953) July.

An automatic Toepler pump is described and illustrated which has given satisfactory service in the sampling of tritium, krypton^{85}, and helium. The pump can be operated at pressures ranging from 0.1 mm Hg to 20 cm Hg and can circulate a gas through a circuit of purification agents. A circulating pump is also described and illustrated which has given satisfactory service for the separation of rare gases. (C.H.)

MINERALOGY, METALLURGY, AND CERAMICS

5640 RMO-2734
Tennessee Valley Authority, Wilson Dam, Ala.
UTILIZATION OF FLORIDA LEACHED ZONE MATERIAL. PROGRESS REPORT [FOR] MARCH 1955. Mar. 30, 1955. Decl. May 11, 1955. 9p.

Results of a study of the effect of moisture on the dry beneficiation of leached zone ore showed that 8% moisture in the minus 55-micron concentrate fraction can be tolerated without serious adverse effect on the efficiency of the beneficiation process. The moisture content of the feed that can be tolerated is less than 8% and depends upon the proportion of potential concentrate it contains. (auth)

5641 RMO-2735
Tennessee Valley Authority, Wilson Dam, Ala.
UTILIZATION OF FLORIDA LEACHED ZONE MATERIAL. PROGRESS REPORT [FOR] APRIL 1955. Apr. 28, 1955. Decl. May 11, 1955. 12p.

A run was made in the pilot plant to demonstrate the production of nitric phosphate fertilizer from calcined, unbeneficiated leached zone ore. The run was made with calcined ore and the acid extraction slurry was filtered on a continuous belt filter. Potassium chloride was added to the ammoniated slurry to produce a three-component fertilizer. About 99% of the P_2O_5 and 96% of the uranium in the ore were solubilized. About 96% of the P_2O_5 and 90% of the uranium in the ore were recovered in the filtrate. About 3.5 tons of 14-14-14 ($N:P_2O_5:K_2O$) fertilizer were produced. About 9.5% of the P_2O_5 was in a water-soluble form. (For preceding period see RMO-2734.) (auth)

5642
IONIC NATURE OF LIQUID IRON-SILICATE SLAGS. M. T. Simnad, G. Derge, and I. George (Carnegie Inst. of Tech., Pittsburgh). J. Metals 6, 1386-90(1954) Dec.

Measurements of current efficiency on iron-silicate slags in iron crucibles showed that conduction is about 10% ionic in slags with less than 10% silica and about 90% ionic in slags with more than 34% silica, increasing linearly in the intermediate range. The balance of the conduction is electronic in character. Silicate ions are discharged at the anode with the evolution of gaseous oxygen. Transport experiments show that the ionic current is carried almost entirely by ferrous ions, which may be assigned to a transport number of one. (auth)

CERAMICS AND REFRACTORIES

5643 WADC-TR-54-13
American Electro Metal Corp., Yonkers, N. Y.
[CERAMIC MATERIALS]. INVESTIGATION OF THE EFFECT OF RAW MATERIAL PRODUCTION VARIABLES ON THE PHYSICAL AND CHEMICAL PROPERTIES OF CARBIDES, NITRIDES, AND BORIDES. Herman Blumenthal. Feb. 1954. 67p. Contract AF33(616)-89. (AD-34141)

The effect of impurities on TiC was studied by partly removing Fe, graphite, and oxide films with acid leaching and flotation, and by introducing TiO, TiN, and graphite into the pure TiC. The effect of various ball-milling media on the chemical composition of the milled product was studied. In the production of unbonded TiC bars, hot-pressing was used exclusively, while Ni-bonded bars were produced by hot-pressing and by cold-pressing followed by sintering either under a protective atmosphere or in vacuum. Hot-pressed unbonded bars were tested for maximum density obtainable, ability to infiltrate, and electrical resistivity. The chemical position of TiC produced by different procedures varied as to combined and free C, O, and N content, and metallic impurities. The amount and kind of impurities influenced the maximum density obtainable by hot-pressing unbonded bars, and their ability to infiltrate. The amount of Fe and O picked up in a steel mill varied greatly with the ball-milling medium. Ni-bonded bars of high density could only be produced by hot-pressing. Cold-pressing followed by sintering in H or in vacuum resulted in bars of low density. The ability of a porous bar to infiltrate depended on its density, impurity content, and particle size of the original powder. (ASTIA abst.)

5644
REVIEW OF HIGH TEMPERATURE METAL-CERAMIC SEALS. Hayne Palmour, III (American Lava Corp., Chattanooga, Tenn.). J. Electrochem. Soc. 102, 160C-4C(1955) July.

A technical review of the development of metal—ceramic seals is presented, with emphasis on methods devised for high temperature brazing of metals to low-loss technical ceramics for electronic applications. Basic mechanisms of metal—ceramic bonding are discussed briefly, as are the problems resulting from mis-match between thermal expansivities of metals and ceramics. Illustrations of feasible design types are shown, and comparative data on electrical and mechanical properties of various technical ceramics (including glass) are listed. (auth)

5645
THERMAL CONDUCTIVITY. XII. TEMPERATURE DEPENDENCE OF CONDUCTIVITY FOR SINGLE-PHASE

CERAMICS. W. D. Kingery (Massachusetts Inst. of Tech., Cambridge). J. Am. Ceram. Soc. 38, 251-5(1955) July.

Theoretical relationships and experimental data concerning thermal conductivity for a number of oxide materials have been compared over a wide temperature range. Deviations from the basic proportionality between k and 1/T are caused by radiant-energy transmission, a high Debye temperature, a low mean free path of the thermoelastic waves, porosity, and in a few cases electronic conductivity. Extrapolation of thermal conductivity data to high temperatures is not reliable. (auth)

CORROSION

5646 ANL-5229

Argonne National Lab., Lemont, Ill.

ANODIZING AS A MEANS OF EVALUATING THE CORROSION RESISTANCE OF ZIRCONIUM AND ZIRCONIUM ALLOYS. R. D. Misch. Dec. 1953. 88p. Contract W-31-109-Eng-38.

Zirconium of varying quality was tested by anodizing at constant voltage and at constant current density. The pattern of film growth was found to be sensitive to metal composition and surface preparation. The relation of anodic film growth to corrosion must take into account certain characteristics peculiar to anodizing. These are chiefly concerned with the electrical field in the oxide and the effect of electrolytes. Zirconium specimens were compared visually after anodizing at constant voltage for times below one hour. Initial work was conducted with a bath (dilute sulfuric and nitric acids) which gave rapid film breakdown on metal of low quality. Later work was conducted with baths giving very slow breakdown. Preliminary correlation with autoclave tests was promising but could not be improved by modification of anodizing conditions. At constant current density (1 ma/cm^2), it was found on series of WAPD specimens that a high maximum voltage was an indication of failure on the 750°F steam test. Zirconium arc-melted at ANL did not confirm this relationship. At a lower current (0.1 ma/cm^2) the rise of the voltage-time curve was found to correlate with metal quality. The electrical conductivity of the oxide layer may be a factor determining corrosion. Residual currents (at a constant voltage) correlated with the voltage-time curves. A semiconductor theory of anodizing is proposed to account for cell-voltage maxima and breakdown. A transition from p to n conductivity (at the inner layer) is believed to be responsible. (auth)

5647

CONSTRUCTION MATERIALS FOR LIQUID SODIUM SYSTEMS. E. G. Brush (Knolls Atomic Power Lab., Schenectady, N. Y.). Corrosion 11, 299t-303t(1955) July.

In pure sodium, engineering alloys may be subject to mass transport effects, preferential solution of alloying constituents and diffusion welding of mating surfaces. Trace amounts of impurities which are difficult to remove result in damaging oxidation and also act to accentuate preferential solution phenomena, particularly decarburization and intergranular attack. The resistance of alloys to attack by sodium has been investigated in static and dynamic laboratory tests and in pilot plant heat transfer systems. Extensive laboratory data and service performance indicate that the design engineer has a wide selection of materials of construction that will give satisfactory service in high temperature sodium systems. (auth)

GEOLOGY AND MINERALOGY

5648

ANOMALOUS URANIUM-LEAD AGES. J. L. Kulp and W. R. Eckelmann. Bull. Geol. Soc. Amer. 66, 767-8(1955) June.

5649

NAVAJOITE, A NEW VANADIUM OXIDE FROM ARIZONA. Alice D. Weeks, Mary E. Thompson, and Alexander M. Sherwood (U. S. Geological Survey, Washington, D. C.). Am. Mineralogist 40, 207-12(1955).

Navajoite, hydrated vanadium pentoxide, is a new mineral found in the Monument No. 2 mine on the Navajo Indian Reservation, Apache County, Ariz. It occurs as a coating around pebbles and sand grains and as thin seams in sandstone and clay lenses in a vanadium-uranium deposit in the Shinarump conglomerate (Triassic). It is dark brown, soft, and fibrous, with silky luster and brown streak. The specific gravity, measured on the Berman balance, is 2.56. The mineral is optically biaxial, probably negative, has parallel extinction, and $\alpha = 1.905 \pm 0.003$, β about 2.02, and γ slightly above 2.02. X is yellowish brown, Y is yellowish brown, and Z is dark brown parallel to fiber length. A chemical analysis shows V_2O_5 71.68%, V_2O_4 3.08, Fe_2O_3 3.58, H_2O 20.30, SiO_2 1.20, and CaO 0.22; total 100.06%, and indicates the formula $V_2O_5 \cdot 3H_2O$. The d-spacings and intensities of lines in the x-ray powder pattern are listed. The unit cell length along the fiber is 3.65 ± 0.03 A. Tentative indexing of the powder pattern suggests that the mineral is monoclinic with $a_0 = 17.43 \pm 0.10$ A, $b_0 = 3.65 \pm 0.03$ A, $c_0 = 12.25 \pm 0.10$A, $\beta = 97° \pm 30'$, and Z = 6. (auth)

5650

RADIOACTIVITY INVESTIGATIONS IN THE CACHE CREEK AREA, YENTNA DISTRICT, ALASKA, 1945. G. D. Robinson, Helmuth Wedow, Jr., and J. B. Lyons. U. S. Geol. Survey Bull. 1024-A, 1955. 23p plus 6 maps. $0.65 (GPO)

In the summer of 1945 an investigation was made for possible placer deposits of radioactive minerals on Cache and upper Peters Creeks in the Yentna district, southern Alaska. Five gravel types of different age or origin—Eocene, late Tertiary, Quaternary glacio-fluvial, Quaternary bench, and the present flood-plain deposits (including tailings from placer mining)—were examined for their content of radioactive minerals. Radioactivity was measured by gamma count, as detected by a portable Geiger-Mueller counter, at 455 field stations, and in 526 rough-screened samples from 8 to 20 per minute; the rough-screened sample gamma counts from 8 to 21. Calculations from counts of carefully screened samples and gravity concentrates tested in the field laboratory show a maximum of 0.009% equivalent uranium even where concentration ratios are 500 : 1 or greater. Sluice-box concentrates with an undetermined but extremely high concentration ratio obtained in 1945 have a maximum of 0.064% equivalent uranium. The equivalent-uranium content of the samples may be due either to particles of radioactive minerals in the mineral aggregate of pebbles or other rock fragments, or to individual mineral grains. Interest in 1945 was focussed on mineral grains, the only material recoverable by normal placer-mining methods. Mineralogic study indicates that the radioactivity is due chiefly to uranium and thorium in zircon, monazite, and uranothorianite. (auth)

5651

SEARCH FOR URANIUM IN THE UNITED STATES. Vincent E. McKelvey. U. S. Geol. Survey Bull. 1030-A, 1955 64p. $0.25 (GPO)

The search for uranium in the United States is the most intensive ever made for any metal during our history. The number of prospectors and miners involved is difficult to estimate, but some measure of the size of the effort is indicated by the fact that more than 500 geologists are employed by government and industry in the work—a number comparable to or larger than the total number of geologists engaged in the study of all other minerals together except oil. The largest part of this search has been concentrated in the Western States. No vein deposit of major importance by world standards has been discovered, but the search has led to the discovery of important minable deposits in sandstones on the Colorado Plateau, Wyoming, and South Dakota and in coals in south Dakota; of large, low-grade deposits of uranium in phosphates in both the western and Florida fields, in black shales in Tennessee, and in coals in the Dakotas, Wyoming, Idaho, and New Mexico; and of some promising occurrences of uranium in vein deposits. Despite the fact that many of the districts considered favorable for deposits of uranium have already been examined, the outlook for future discoveries is bright, particularly for uranium in sandstone and vein deposits in the Rocky Mountain States. (auth)

METALS AND METALLURGY

5652 AD-13866
Dow Chemical Co. Metallurgical Labs., Midland, Mich.
FURTHER DEVELOPMENT OF POWDER FABRICATED MAGNESIUM ALLOYS, PART 1. QUARTERLY REPORT NO. 3 [COVERING THE PERIOD JANUARY 1 TO APRIL 1, 1953]. 14p. Contract AF(600)19147.

Simultaneous melt additions of 1% Th, 1% MM, 0.1% Ca and 1% Ag were made to ZK60 in a factorial experiment to determine their effects in extrusions. It was found that ZK60 containing MM or Ca has properties and extrudability comparable to ZK60—Th. None of the simultaneous additions are significantly better than these single additions. The addition of MM considerably decreases the corrosion rate of the alloys, particularly those containing Ag. Only two significant interactions were obtained. MM interacts favorably with Ag on mechanical properties, extrudability, and corrosion rate and unfavorably with Ca on mechanical properties. (auth)

5653 AD-22321
Rensselaer Polytechnic Inst., Troy, N. Y.
MAGNESIUM SHEET ALLOYS. [QUARTERLY] PROGRESS REPORT NO. 2 [FOR] MAY, JUNE AND JULY 1953. R. R. Nash. Aug. 3, 1953. 20p. Contract AF 33(616)-439.

Experimental conditions are described for preparing 96 alloys with single and double additions of chromium, antimony, strontium and barium to AZ31 base composition. Preliminary chemical analysis indicates that the addition of chromium by means of an aluminum—chromium hardener permits a greater recovery of chromium in the AZ31 composition than electrolytic chromium powder. The retention of chromium in AZ31 is small regardless of the method of addition. Limited evidence indicates that the recovery of antimony and barium in AZ31 is much higher than for chromium, being 36 and 88%, respectively, of the intended additions. Longitudinal tensile mechanical properties are presented for 0.064 in. sheet in the as-fabricated condition for 48 alloys containing single and double additions of chromium, antimony, strontium and barium to AZ31. As a general trend all of the additions produced an increase in the strength property level, particularly in the ratio of tensile yield to tensile ultimate strength. (auth)

5654 AD-32084
American Electro Metal Corp., Yonkers, N. Y.
INVESTIGATION AND EVALUATION OF NEW HIGH TEMPERATURE MATERIALS. PROGRESS REPORT NO. 5 [COVERING THE PERIOD] NOVEMBER 1, 1953 TO FEBRUARY 28, 1954. William Arbiter. 44p. Contract AF 33(616)-109.

A large number of compositions have been prepared in the chromium—titanium—oxygen system and these, together with many formerly reported, have been treated on the basis of the ternary system Cr—Ti—O and equilibrium phases for these compositions have been calculated on the basis of chemical analysis. Average properties of hot-pressed compositions are given for most of these materials and in some cases the average properties of sintered compositions are also given. (auth)

5655 BMI-1006
Battelle Memorial Inst., Columbus, Ohio.
EMBRITTLEMENT OF MULTIPASS WELDS IN ZIRCALOY 2. John T. Niemann and Raeman P. Sopher. June 14, 1955. 19p. Contract NObs-65057.

The properties of multipass welds in Zircaloy-2 were investigated. It was found that during the first pass compounds were dissolved at the high temperature and retained in solution owing to the rapid cooling. Deposition of the second pass reheated the first pass and caused precipitation of the compounds. This precipitation resulted in reduced ductility and impact strength. However, the embrittling effect does not appear to be so large as to be serious. The ductility could be improved by postweld treatment. The best combination of properties was obtained by water quenching from 1600 F. At this temperature, the compounds are in solution, and the fast cooling rate suppresses precipitation. (auth)

5656 NAA-AL-2064
North American Aviation, Inc., Downey, Calif.
WELDABLE TITANIUM ALLOY DEVELOPMENT PROGRAM. PROGRESS REPORT NO. 1. C. W. Handova and J. T. Milek. Oct. 26, 1954. 15p. Contract W33 (038) ac-14191. (AD-49670)

This report outlines the scope of the Ti weldability program and includes compositions and materials evaluated to date. A limited amount of tensile data is available and some bend tests have been performed on Ti—Al—V alloys. The alloy compositions tested have excellent bendability. The mechanical properties are not adversely affected by thermal treatment in the range 1100 to 1700°F for one hour and air-cooled. (auth)

5657 NP-5690
Mine Safety Appliances Co., Callery, Penna.
PROGRESS REPORT NO. 28 FOR APRIL AND MAY 1955. J. W. Mausteller, ed. June 21, 1955. 70p. Contract NObs-65426.

Tests on the Mark B 3000-Kw steam generator were continued. Engineering studies are summarized on vent and line closures, cross flow exchanger, electromagnetic pumps, pressure gages, liquid metal leakage, alkali liquid metal surface wetting, corrosive effects and waste disposal of Na, and testing of Mark A and B bellows, valves, and apparatus for thermal shock measurements. The changes in the solubility of Na_2O in liquid Na due to the addition of Na or K were investigated. Mass transfer inhibition was examined. The removal of radioactive Na by flushing was investigated. Loop tests and pipe-flushing tests and pipe-flushing tests were continued. The radiation hazards arising from leaks in the water cooling system of a reactor and the possible chemical reactions between water and molten metals were studied. (For preceding period see NP-5601.) (C.W.H.)

5658 NP-5691
Horizons, Inc., Cleveland.
INVESTIGATION OF A NEW METHOD FOR THE DETERMINATION OF THE COEFFICIENTS OF SURFACE DIFFUSION OF METALS. QUARTERLY PROGRESS REPORT NO. 8. Peter F. Mataich. June 1, 1955. 17p. Contract AF18(600)-644.

The work on the use of radioactive tracers to measure surface diffusion of metals is discussed. The diffusion system studied deals with a definite quantity of matter which is deposited as a strip on the surface of a solid and is left to diffuse over it. Experimental procedure is outlined. (auth)

5659 NP-5695
Crane Co., Chicago.
RELAXATION BEHAVIOR OF TITANIUM ALLOYS. QUARTERLY PROGRESS REPORT NO. 4. E. A. Sticha. Apr. 15, 1955. 11p. Contract AF 33(616)-2400.

An evaluation of the relaxation behavior of Ti alloys was made to assist in applications of the alloys as fasteners offering possibilities of weight saving in aircraft. Data are tabulated on effect of relaxation testing, hardness, and impact characteristics. (For preceding period see NP-5572.) (J.E.D.)

5660 NP-5699
Illinois. Univ., Urbana.
THE ELECTRON MICROSCOPY OF ALUMINUM CRYSTALS DEFORMED AT VARIOUS TEMPERATURES (thesis). Thomas Sherman Noggle. June 1955. 91p. Contract N6ori-071(54), Technical Report No. 2.

Examination of the surface structures of aluminum deformed at low temperatures was made. In view of the differences in the structures reported by different investigators (who also used different replica methods), some preliminary work on aluminum deformed at room temperature was carried out. Using both the aluminum oxide and silicon monoxide replica methods, it was established that the results obtained by both methods were in general agreement with each other and with the results published by Kuhlman and Wilsdorf. Supplementary data on stress-strain behavior and from x-ray examination were also obtained. (auth)

5661 NYO-7045
Massachusetts Inst. of Tech., Cambridge.
THERMODYNAMIC PROPERTIES OF SOLID ALUMINUM–SILVER ALLOYS. TECHNICAL REPORT NO. 20, SCOPE II. Mats Hillert, B. L. Averbach, and Morris Cohen. May 31, 1955. 21p. Contract AT(30-1)-1002.

The relative thermodynamic properties of the Al–Ag system have been determined in the temperature range 642 to 820°K by means of emf measurements and compared with the local atomic arrangements determined from diffuse x-ray scattering. Qualitative agreement is obtained with both the quasi-chemical and Friedel's theory. (auth)

5662 SO-2040
General Electric Co. Research Lab., Schenectady, N. Y.
THERMODYNAMICS OF LIQUID Ag–Au AND Au–Cu ALLOYS AND THE QUESTION OF STRAIN ENERGY IN SOLID SOLUTIONS. R. A. Oriani. July 1955. 25p. Contract W-31-109-Eng-52. (55-RL-1329)

The experimental details and the results of a galvanic cell investigation of the thermodynamics of liquid gold-copper and solid and liquid silver-gold solutions are described. The heats of solution are compared with the predictions of several theories. The concept of strain energy in a solid solution is discussed, and the suggestion of Lumsden and of Wagner that $\Delta(\Delta H)$ is a measure of strain energy is supported by the present results and by arguments from the calculations of H. Jones. Elasticity theory calculations are discussed, and strain energy in a solid solution is defined as the energy change caused by the imposition of a lattice on a liquid solution. (auth)

5663 WADC-TR-52-322(Pt.2)
Battelle Memorial Inst., Columbus, Ohio.
CAUSES OF CRACKING IN HIGH-STRENGTH WELD METALS. [SUMMARY REPORT FOR THE PERIOD AUGUST 12, 1952 TO AUGUST 12, 1953]. A. J. Jacobs, P. J. Rieppel, and C. B. Voldrich. Feb. 1954. 45p. Contract AF33(038)-12619. (AD-30560).

The causes of cracking in high-strength weld metals have been investigated. Results indicate that low sulfur contents are associated with high hot ductility and high resistance to hot cracking. (C.W.H.)

5664 WADC-TR-53-336(Pt.2)
California. Univ., Berkeley.
[DESIGN AND EVALUATION DATA FOR STRUCTURAL METALS]. THE CREEP PROPERTIES OF METALS UNDER INTERMITTENT STRESSING AND HEATING CONDITIONS. PART 2. INTERMITTENT HEATING. Lawrence A. Shepard, C. Dean Starr, Carl D. Wiseman, and John E. Dorn. July 1954. 36p. Contract AF33(038)-11502. (AD-49099)

Intermittent temperature, constant load creep tests were performed on clad aluminum alloys 75S-T6 and 24S-T3 at 450°F, and the test data are reported. Aluminum alloy 75S-T6 creep specimens were held at 450°F for $1\frac{1}{2}$ hrs out of every two-hour temperature cycle. During the remaining half hour of the two hour temperature cycle the specimens were cooled to room temperature, and then reheated to 450°F prior to the start of the next 2 hr cycle. The 24S-T3 aluminum alloy specimens were held at 450°F for 1 hr out of every two. During the remaining hour of the two hour temperature cycle the specimens were cooled to room temperature, held at room temperature and then reheated to 450°F prior to the start of the next two hour cycle. All specimens were maintained under constant load throughout the test. Comparison of cyclic temperature creep data obtained in this investigation with isothermal data under the same conditions of stress reveal that approximately equivalent plastic strains are achieved when the comparison is made on the basis of net time at test temperature. (auth)

5665 WAL-401/84-42
Illinois Inst. of Tech., Chicago. Armour Research Foundation.
SURFACE HARDENING OF TITANIUM WITH METALLOID ELEMENTS. INTERIM TECHNICAL REPORT NO. 5 FOR THE PERIOD JUNE 1, 1954–November 30, 1954. A.

Siede and Verne Pulsifer. [Includes Appendix: DERIVATION OF FORMULAS APPLICABLE TO THE ARMOUR RESEARCH FOUNDATION WEAR TEST PROGRAM]. 47p. Contract DA-11-002-ORD-1319.

Investigation of nitriding titanium in commercial type furnaces established that gas purification and furnace leakage problems may be overcome through the use of high-grade commercially available nitrogen and welded retorts. The investigation of the effects of various gas mixtures on case depth and depth hardness curves indicates that oxygen may be a useful hardening agent in surface hardening titanium. The mechanical testing performed in this investigation indicates surface hardened titanium may be very notch sensitive and, therefore, may be of limited applicability. The wear testing indicates nitrided titanium exhibits extremely low wear rates at low contact pressures, but is relatively pressure sensitive. (auth)

5666 WAL-401/93-35
Case Inst. of Tech., Cleveland.
INVESTIGATION OF THE MECHANICAL PROPERTIES OF TITANIUM BASE ALLOYS. F. R. Brotzen, E. L. Harmon, and A. R. Troiano. Apr. 30, 1955. 29p. Contract DA-33-019-ORD-941, Technical Report No. 4.

The nature and the decomposition kinetics of martensitically transformed alpha titanium (α') were studied, utilizing x-ray-diffraction techniques and electrical resistance and hardness measurements. Lattice parameter determinations disclosed that the $\underline{c}$ parameter of the hexagonal, supersaturated alpha lattice followed Vegard's Law for compositions up to 10% vanadium. The $\underline{a}$ parameter varied linearly with composition up to about 7.5% vanadium, but deviated noticeably for the 10% vanadium alloy. The hardness was mildly increased by supersaturation. The kinetics of α' decomposition were investigated for a 7.5% vanadium alloy by observing electrical resistance changes. By correlating the change in resistance with the amount of material transformed, it was established that the kinetics of α' decomposition in titanium were similar to those of the first stage of martensite tempering in steel. The results further indicated that the precipitation of equilibrium beta from supersaturated alpha titanium is a diffusion controlled process with an activation energy for the tempering reaction of about 15,000 cal/mole. (auth)

5667 WAL-401/215
New York Univ., New York. Coll. of Engineering.
THE YIELD POINT IN POLYCRYSTALLINE TITANIUM. FINAL REPORT. H. Margolin and K. Hall. Sept. 30, 1954. 89p. Contract DA-30-069-ORD-1217.

The elements responsible for strain aging effects were determined. Mechanical properties and stress-elongation curves in the temperature range from 77 to 788°K (−196 to 515°C) were determined for iodide titanium, Ti−O, Ti−N, Ti−C and Ti−H alloys. Data were obtained on the relationship between yeidl point phenomena and grain size, between lower yield stress and yield point elongation, and lower yield stress and strain hardening from the lower yield point. Experiments on rate of return of the yield point were carried out. Oxygen, nitrogen, carbon and, to a small extent, hydrogen, produce strain aging effects in titanium. (auth)

5668
PLASTIC DEFORMATION OF ALUMINIUM-3.5% COPPER ALLOY SINGLE CRYSTALS. K. M. Carlsen and R. W. K. Honeycombe (Univ. of Sheffield, England). J. Inst. Metals 83, 449-54(1955) June.

Long crystals of an aluminium—3.5% copper alloy, prepared by the strain-anneal method, have enabled a comparison to be made of specimens of identical orientation after different heat-treatments. Three conditions were investigated: (i) air-cooled from 535°C., (ii) air-cooled and aged 3 days at 190°C ; (iii) air-cooled and overaged 2 days at 350°C, furnace-cooled to 250°C, held 1 day, and then furnace-cooled to room temperature. Crystals of the air-cooled solid solution resembled pure metals, in so far as plastic deformation occurred on well-defined slip planes and the stress/strain curves were orientation-dependent. The deformation continued on the chosen system, suitably oriented alternative systems not becoming operative until heavy deformations were reached. In contrast, the fully hardened crystals did not show visible slip, not did they undergo the change in shape expected from deformation on a single set of planes; furthermore, the stress/strain curves were independent of orientation. The behavior of the overaged crystals fell between these two extremes. The work-hardening of the aged and overaged crystals was greater than that of the solid solution crystals, particularly when tested at −196°C. At room temperature the air-cooled solid-solution crystals, on interruption of the deformation, gave stepped stress/strain curves, which are explained in terms of accelerated ageing on the slip planes. Differences in the rate of work hardening in the solid-solution and in the aged crystals are discussed in terms of the barriers which may prevent movement of dislocations. (auth)

5669
DIFFUSION IN LIQUID LEAD-BISMUTH ALLOYS. R. E. Grace and G. Derge (Carnegie Inst. of Tech., Pittsburgh). J. Metals 7, 839-42(1955) July.

Diffusivity of bismuth in liquid Pb-Bi alloys has been measured by the capillary reservoir method as a function of temperature and composition. Fair agreement between theory and experiment is found for the measured diffusion coefficients and activation energies of diffusivity and viscosity in dilute lead alloys. The measured diffusion coefficients in the high bismuth alloys describe mass transport in special concentration gradients. (auth)

5670
DETERMINATION OF DIFFUSION COEFFICIENTS ON THE BASIS OF BETA RADIATION ABSORPTION. A. A. Zhukhovitskii and V. A. Geodakyan (Moscow Steel Inst.). Doklady Akad. Nauk S.S.S.R. 102, 301-4(1955) May 11. (In Russian)

5671
DETERMINATION OF TITANIUM IN TITANIUM METAL. Roland A. Papucci (F. C. Broeman and Co., Cincinatti). Anal. Chem. 27, 1175-6(1955) July.

A method is presented for the direct determination of Ti in Ti metals. The Eberbach Dyna-Cath, high-speed mercury cathode is used to separate Ti from the most common and interfering elements present as impurities in Ti metal. Ti is then determined colorimetrically as the yellow pertitanic acid. (C.W.H.)

5672
ON THE STRUCTURE OF EVAPORATED THIN FILMS OF METALS. Shiro Ogawa, Denjiro Watanabe, and F. Eiichi Fujita (Tohoku Univ., Sendai, Japan). J. Phys. Soc. Japan 10, 429-36(1955) June.

It has been confirmed by many electron diffraction works that the single-crystal-like films of silver, gold, copper, and nickel which are formed on heated cleavage surfaces of rocksalt by evaporation in vacuo have the repeated twinning structures. However, the thickness, the area, and the repeat frequency of the twinned layer have not yet been studied. The present work was undertaken to study these points by means of electron microscope. Parallel, linear stripes are observed in electron micrographs of the films. These stripes are attributed to the twinned lattice, the thickness of which is of the order of 100 A. Parallel, linear stripes are not observed for aluminium. This agrees with the fact that no twinning occurs in this metal. (auth)

5673

ON PRODUCING THIN SINGLE CRYSTAL FOILS OF ALUMINIUM WHICH HAVE ANY DESIRED CRYSTALLOGRAPHIC ORIENTATIONS. Hiroshi Fujiwara (Univ. of Tokyo) and Takao Ichiki (Hiroshima Univ.). J. Phys. Soc. Japan 10, 468-71(1955) June.

Aluminium single crystal foils (0.06 × 5 × 100 mm^3, 99.53% in purity) having definite crystallographic orientations have been produced; for example, they are orientated in [110]—(110) or [110]—(100) or D_s or D_d, etc. It was found that the easiness with which a single crystal foil was produced was remarkably different according to its crystallographic orientation. For the specimens D_s and D_d, it was also found that the bending behaviors caused by some mechanical shock were different from each other. (auth)

5674

L ABSORPTION SPECTRA OF GOLD IN GOLD—SILVER ALLOYS. Chintamani Mande. Compt. rend. 240, 2222-24 (1955) June 6. (In French)

The L absorption spectrum studies previously reported (Comp. rend. 240, 1205(1955)) for Au—Pd alloys have been extended to Au—Ag alloys. Particular attention is given to the shape of the L_{III} absorption discontinuity. Differences in the form of this discontinuity between Au—Pd and Au—Ag alloys are attributed to changes in the density of gaseous electronic states in these substances. (K.S.)

5675

ON THE SYMMETRY OF TEXTURES IN ROLLED URANIUM. Anatole Winogradzki. Compt. rend. 240, 2235-7(1955) June 6. (In French)

5676

BOMB REDUCTION OF MOLYBDENUM TRIOXIDE BY CALCIUM METAL. H. L. Gilbert and F. E. Block (U. S. Bureau of Mines, Albany, Oreg.). J. Electrochem. Soc. 102, 394-8(1955) July.

Molybdenum trioxide has been reduced by calcium in a sealed bomb to produce massive reguli of molybdenum metal. A full description of the production of 25 lb reguli is given. Reguli are joined and employed as a consumable electrode in arc melting to produce ingot. Metal may be hot forged and rolled to desired form. (auth)

5677

THE THERMODYNAMIC STABILITY OF REFRACTORY BORIDES. Leo Brewer (Univ. of California, Berkeley) and Haakson Haraldsen (Universitetes Kjemiske Institutt, Blindern, Oslo, Norway). J. Electrochem. Soc. 102, 399-406 (1955) July.

Reactions between nitrogen gas and metal borides and between graphite and metal borides have been studied to obtain qualitative information on the relative stabilities of the metal boride phases. At high temperatures many borides are inert toward carbon or nitrogen. The most stable borides are found to be those of Ti, Zr, Nb, and Ta of the fourth and fifth groups of the periodic table. Data are summarized in terms of limits to the heats of formation. (auth)

5678

HIGH TEMPERATURE OXIDATION OF TWO ZIRCONIUM-TIN ALLOYS. M. W. Mallett and W. M. Albrecht (Battelle Memorial Inst., Columbus, Ohio). J. Electrochem. Soc. 102, 407-14(1955) July.

The rates of oxidation of Zr—1.5 wt. % Sn and Zr—2.5 wt. % Sn alloys in the temperature range 550° to 900°C were determined and activation energies for the reactions were calculated. Adherent gray-black oxidation films were found to be N-type semiconductors and from this a mechanism for the oxidation of Zr is proposed. (C.W.H.)

PHYSICS

5679 NBS-4094

National Bureau of Standards, Washington, D. C.

A SIMPLE, OBJECTIVE, TEST FOR CABLE NOISE DUE TO SHOCK, VIBRATION OR TRANSIENT PRESSURES. Thomas A. Perls. May 1955. 21p. Sponsored by ONR; OSR; and AEC under contracts NAonr-21-48 and CS-640-55-9.

A test method has been developed to obtain an objective, reproducible "noise index" for cables in which the low-noise properties are of interest. The mechanical and electrical features of the test method are described, together with theoretical and experimental considerations which led to their choice. Sample noise indices are given for three widely used coaxial cables and for the recently developed NBS low-noise cable. Noise indices for commercially available low-noise cables were found to cover a range of over 10,000 to 1. (auth)

5680 NM-006-012.04.64

Naval Medical Research Inst., Bethesda, Md.

DESIGN AND CONSTRUCTION OF A RADIOCOBALT LARGE ANIMAL IRRADIATOR. R. Harold Draeger, Richard H. Lee, Thomas E. Shea, Jr., Frank I. Whitten, and Maynard Eicher. Dec. 2, 1953. 18p.

A large animal irradiator has been designed and constructed utilizing 1200 curies of radiocobalt as a source of gamma radiation. The radioactive material is divided into 100 portions of approximately 12 curies which are contained in capsules within 60 pneumatic carrier tubes. The tube system connects two radiation chambers separated by a radiation shield. This arrangement permits either of the two chambers to be entered whenever the radioactive material is pneumatically transferred to the other. In one radiation chamber the carrier tubes are disposed in a radial manner providing a volume about 32 inches in diameter and 5 feet long in which a highly uniform radiation dose rate of about 20 r per minute is attained. In the other chamber the tubes are clustered as closely as possible providing a smaller volume about 10 inches in diameter and 30 inches long in which the radiation level is about 200 r per minute. The equipment is housed in a reinforced concrete building which is divided by a heavy radiation shield into two radiation exposure rooms and a control room. (auth)

5681 NP-5703
Iowa State Coll., Ames.
ORGANO-METALLIC AND ORGANO-METALLOIDAL HIGH TEMPERATURE LUBRICANTS AND RELATED MATERIALS. PROGRESS REPORT FOR APRIL 1, 1955 TO JUNE 30, 1955. 23p. Contract AF33(616)-94.

Viscosity data are reported for twenty-six organic compounds of Si, Ge, and Sn. (For preceding period see NP-5595.) (C.W.H.)

5682 AEC-tr-2177
SURFACE TENSION AND CRYSTALLIZATION. SURFACE TENSION OF SOLUTIONS OF MOLTEN SALTS. PARTS I, II, AND III. V. K. Semenchenko and L. P. Shikhobalova. Translated from Zhur. Fiz. Khim. 21, 612-22; 707-14; 1387-1401(1947). 56p.

The influence of the same identical impurities both on the surface tension and crystallization of a molten salt was experimentally and theoretically investigated. (auth)

5683
STYROFOAM CONTAINERS FOR LIQUID HYDROGEN USED IN NUCLEAR EXPERIMENTS. L. Marshall (Institute for Nuclear Studies, Chicago). Rev. Sci. Instr. 26, 614-15(1955) June.

The fabrication, assembly, and advantages of these containers are discussed. The containers are made in such a way that the cold H_2 gas evaporating spills over the edge of the liquid holder and flows between its walls and the walls of an outer jacket, cooling both of them. In principle, a good container is made of many thin-walled concentric jackets between whose walls the gas flows in a reverse re-entrant manner, first down, then up, etc. (L.M.T.)

5684
PRESSURE-VOLUME ISOTHERMS OF He^3 BETWEEN 1.5 AND 3.8°K. William E. Keller (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. 98, 1571-5(1955) June 15.

PV isotherms of He^3 gas have been measured at 3.786, 2.991, 2.161, 1.818, and 1.516°K. Values of the second virial coefficient, B, derived from the data, are, respectively, −65.37, −86.25, −117.9, −142.3, and −168.0 cc/mole. For only the isotherms of 3.786 and 2.991°K was the third virial coefficient found to be significant. These values are 1132 and 1718 $cc^2/mole^2$, respectively. The measured B's are shown to be in satisfactory agreement with those calculated using a modified Slater-Kirkwood type potential, with constants chosen to give a good fit to the measured He^4 B's below 4°K. (auth)

5685
THERMODYNAMIC PROPERTIES OF LIQUID HELIUM THREE. 1. THE SPECIFIC HEAT AND ENTROPY. Thomas R. Roberts and Stephen G. Sydoriak (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. 98, 1672-8(1955) June 15.

Specific heats of saturated liquid He^3 have been measured between 0.37° and 2.36°K. The data fit the empirical equation, $C = 0.577 + 0.388T + 0.0613T^3$ (cal/mole deg), to about ±1.0% between 0.5° and 1.7°K. The standard deviations of most of the individual points are between 1 and 2%. Entropy differences are calculated from the above equation and combined with a value of entropy of 1.44 cal $mole^{-1}$ deg^{-1} at 0.5°K to give the total entropies. The difference between the total entropy and the entropy of nuclear spin disorder is remarkably linear with and nearly proportional to T. The present and earlier warmup experiments give no indication of existence of a specific heat anomaly in liquid He^3 between 3.21°K and 0.37°K. The present work also shows that a λ transition comparable to that occurring in liquid He^4 will not be found in liquid He^3 at any temperature below 0.37°K. (auth)

COSMIC RADIATION

5686
APPARATUS FOR MEASURING THE INTENSITY OF COSMIC RADIATION AT GREAT DEPTHS IN THE SEA. J. C. Barton (University Coll. of the West Indies, Jamaica). J. Sci. Instr. 32, 226-9(1955) June.

A portable cosmic-ray equipment and an aluminum alloy pressure vessel in which it can be enclosed are described. The apparatus consists of a three-fold coincidence arrangement of Geiger-Müller counters operated entirely from dry batteries. The total power consumption is about ¼ W and one set of batteries is sufficient for a week's continuous operation. A small portable scaler which can be used in conjunction with this apparatus is also described. (auth)

5687
FLUCTUATIONS IN THE NUMBER OF PHOTONS IN AN ELECTRON-PHOTON CASCADE. Alladi Ramakrishnan and S. K. Srinivasan (Univ. of Madras, India). Progr. Theoret. Phys. (Japan) 13, 93-9(1955) Jan.

Numerical results are given relating to the mean and mean square number of photons in a cosmic ray cascade to supplement those given earlier by Ramakrishnan and Mathews relating to electron distribution. (auth)

5688
ON THE PENETRATING SHOWERS PRODUCED IN PARAFFIN AND GRAPHITE. Isao Miura, Tsuneo Matano, Yoshio Toyoda, and Takashi Murayama (Nagoya Univ., Japan). Progr. Theoret. Phys. (Japan) 13, 115-17(1955) Jan.

A cloud chamber 2700 meters above sea level was used to study meson production in hydrogen. A comparison of showers produced in paraffin and in graphite gave information on the nature of showers in hydrogen. Multiplicity distribution of showers considered to be nucleon-hydrogen collisions is given. (B.J.H.)

5689
PHYSICAL PROCESSES IN OUTBURSTS OF NOVAE IN ENVELOPES OF WOLF-RAYET AND P CYGNI STARS AND THE THE ORIGIN OF COSMIC RAYS. I. M. Gordon. Doklady Akad. Nauk S.S.S.R. 102, 233-6(1955) May 11. (In Russian)

5690
ANGULAR DISTRIBUTION IN COSMIC RAY STARS. E. Lohrmann. Nuovo cimento (10) 1, 1126-40(1955) June. (In English)

The angular distribution of star-producing particles and their secondaries was measured under absorbers of Fe, Sn, and C at altitudes of 2,960 m (Zugspitze) and 420 m (Weissenau). The angular distribution of ionizing star-producing particles can approximately be represented by a $\cos^6 \theta$ law at 2,960 m and by $\cos^{5.7} \theta$ at 420 m. With increasing energy of the particles the distribution appears to be more strongly collimated towards the vertical. The angular distribution of grey tracks around the direction of the star-producing particle agrees with results of the Bristol Group for stratosphere altitudes, suggesting the distribution to be independent of the energy of the star-producing particle. With increasing energy of the secondaries an increasing collimation of the angular distribution is observed. The angular distribution of grey tracks relative to the vertical is given for neutron- and for proton-induced stars respectively.

An attempt was made to derive the angular distribution of the neutral star producing component leading to a $\cos^n \theta$ law with $1 < n < 4$. (auth)

5691

ON THE TOPOGRAPHIC DISTRIBUTION OF COSMIC RAY STARS IN NUCLEAR EMULSION. E. Lohrmann. Nuovo cimento (10) 1, 1141-5(1955) June. (In English)

Cosmic-ray stars are found to have a completely random distribution at distances < 500 μ in nuclear research emulsions which had been exposed under different absorbers at mountain altitudes. This random distribution is not influenced by transition effects of the star frequency. (auth)

5692

ON THE ZENITHAL EFFECT OF EXTENSIVE AIR SHOWERS. D. Brini, O. Rimondi, and U. Valdre (Univ. of Bologna, Italy) and I. Filosofo (Univ. of Padova, Italy). Nuovo cimento (10) 1, 1269-72(1955) June.

The zenithal dependence function for large air showers at low altitude is expressed, for small zenithal angles θ, as $f(x,\theta) = \cos^n\theta$, where x is the atmospheric depth measured from the highest limit of the atmosphere. Measurements are made here to determine the value of n, particularly at sea level. A value of $n = 6$ is obtained, and the influence of large zenith angles is 20% at 40°, and 5% at 50°. (K.S.)

CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE

5693 NYO-7046

Massachusetts Inst. of Tech., Cambridge.

ON THE ORDERED STRUCTURE PROPOSED FOR Li_3Mg_5. TECHNICAL REPORT NO. 21, SCOPE II. F. H. Herbstein and B. L. Averbach. May 31, 1954. 8p. Contract AT(30-1)-1002.

ELECTRICAL DISCHARGE

5694

MEASUREMENT OF THE WAVELENGTHS OF MAXIMUM INTENSITY FOR X-RAY TUBE SPECTRA. Alan D. K. Laird (Univ. of California, Berkeley). J. Opt. Soc. Amer. 45, 568-71(1955) July.

A new method is described for measuring the wavelength of peak intensity of x-ray tubes. This method employs known absorption data and gives an independent check on crystal spectrometer measurements. For a tungsten target tube, the measured values were: 50.0 kv spectrum peak at 0.337 A, 45.5 kv at 0.367 A, 39.8 kv at 0.416 A, and 33.5 kv at 0.478 A. An important companion result is the variation of intensity with tube potential, at constant wavelengths shorter than the peak wavelengths, for spectra corresponding to tube potentials between 30 and 70 kv. (auth)

5695

SELF-FOCUSING STREAMS. Willard H. Bennett (Naval Research Lab., Washington, D. C.). Phys. Rev. 98, 1584-93 (1955) June 15.

Streams consisting of a mixture of ions and electrons in which the average velocity of the electrons in the direction of the stream is different from the average stream velocity of the ions can be magnetically self-focusing. The random velocities of the electrons and ions about their respective average stream velocities do not need to be Maxwellian. The only condition which must be met is that the total electric current in stream must exceed a critical value which can be calculated in terms of the stream velocities and the average kinetic energies of the particles due to components of velocity transverse to the axis of the stream. Streams containing both slow and fast particles of like kind tend to eject the slo particles and keep the fast ones. Streams of particles of one kind only, entering an ionized or ionizable region can be self focusing. Axial asymmetries grow in arcs but disappear in low-density self-focusing streams. (auth)

5696

PASSAGE OF CHARGED PARTICLES THROUGH PLASMA. Jacob Neufeld and R. H. Ritchie (Oak Ridge National Lab., Tenn.). Phys. Rev. 98, 1632-42(1955) June 15.

The plasma has been treated phenomenologically as a homogeneous dispersive medium characterized by a "dielectric constant" which is a function not only of the frequency of the applied field (as in conventional dispersive media) but also on its wave number. The representation of plasma as a dispersive medium is subject to certain validity criteri which are satisfied for such typical cases as the ionosphere and electrical discharge through gases but is not satisfied for electrons in the conduction band of a metal. The passage of charged particles through plasma is investigated by mean of straightforward application of Maxwell's equations for a dispersive medium. The Debye screening, which is applicable to the potential of an incident particle having velocity $V \ll (v^2)^{1/2}$ (where $(v^2)^{1/2}$ is the root mean square velocity of plasma electrons), loses its significance when $V \gg (v^2)^{1/2}$; and in the latter case, the potential decreases with the distance in accordance with an inverse cube law. The stopping power has been calculated for slow incident charged particles having $V \ll (v^2)^{1/2}$ and for fast particles having $V \gg (v^2)^{1/2}$ in a plasma comprising electrons distributed in accordance with Maxwell-Bolzmann and Fermi-Dirac statistics. For slow particles the results represent an extension of the formula of Fermi and Teller. An expression has been derived for the distribution of the polarization density in the space surrounding a moving particle. (auth)

ELECTRONS

5697 AECU-3042

RAND Corp., Santa Monica, Calif.

GRÜNEISEN'S LAW AND THE FUSION CURVE AT HIGH PRESSURE. J. J. Gilvarry. Apr. 11, 1955. 31p. For Univ. of Calif. Radiation Lab., [Berkeley. Contract W-7405-eng-48], Subcontract SC-64. (RM-1457-AEC)

The correction to Grüneisen's law corresponding to the effect of the electrons at high pressure is determined, on the assumption that the lattice contribution to the pressure is small, and that the equation of state of the solid can be approximated by results of the statistical Thomas-Fermi atom for the electron pressure. Under the same assumptions, the fusion temperature as a function of pressure is obtained from a generalization of Lindemann's law. The theory presented yields a general method of determining the corrections, corresponding to lattice contributions, in thermodynamic functions determined from the Thomas-Fermi model. (auth)

5698

ENERGY LOSS DISTRIBUTION FOR MINIMUM IONIZING ELECTRONS IN A PRESSURE PROPORTIONAL COUNTER. E. F. Bradley (Atomic Energy Research Establishment, Harwell, Berks, England). Proc. Phys. Soc. (London) A68, 549-51(1955) June.

Electron energy loss distribution was studied in an argon-methane counter at various pressures. Minimum ionizing electrons were used. Experimental values of most probable energy loss are tabulated. (B.J.H.)

5699

EXPERIMENTAL CROSS SECTION FOR PHOTODETACHMENT OF ELECTRONS FROM H^- AND D^-. Lewis M. Branscomb and Stephen J. Smith (National Bureau of Standards, Washington, D. C.). Phys. Rev. 98, 1028-34(1955) May 15.

The photodetachment of electrons from atomic hydrogen negative ions has been studied, and the integrated cross section measured by using the radiation from a tungsten filament at 3300°K in a modulated crossed-beam experiment. The wavelength dependence of the cross section is measured from 4000 to about 9000 A by using sharp-cut glass filters. The ratio of the experimental integrated cross section to the value predicted theoretically by Chandrasekhar is 1.01, with a 2% reproducibility and 10% upper limit to the systematic errors. (auth)

GASES

5700 NBS-4067

National Bureau of Standards, Washington, D. C.
IDEAL GAS THERMODYNAMIC FUNCTIONS OF THE ISOTOPIC HYDROGEN SULFIDES. Lester Haar, Joe C. Bradley, and Abraham S. Friedman. Apr. 20, 1955. 23p.

Work supported in part by the Division of Research, AEC.

The ideal gas thermodynamic functions for H_2S, D_2S, T_2S, HDS, HTS, and DTS were calculated from molecular data. The recent spectroscopic data for H_2S and D_2S by Allen [Private Communication] were employed. The zero-order frequencies for the other isotopes were obtained by a normal coordinate treatment. The partition functions are obtained in closed form. The calculations include high-temperature corrections for vibrational anharmonicity rotation-vibration coupling, centrifugal stretching, and a low-temperature correction for non-classical rotation. The statistical calculations were performed on the National Bureau of Standards digital computer. Tables of C_p^0/R, $(H^0-E_0^0)/RT$, $-(F^0-E_0^0)/RT$, and S^0/R have been calculated at close temperature intervals from 50°–5000°K. (auth)

5701

SYMMETRY EFFECTS IN GAS KINETICS. 1. THE HELIUM ISOTOPES. O. Halpern (c/o American Express Co., Zurich, Switzerland) and R. A. Buckingham (Univ. College, London, England). Phys. Rev. 98, 1626-31(1955) June 15.

Continuing earlier investigations, discussion is given in this paper of the influence of the process of symmetrization of the wave functions of the colliding atoms upon various gas-kinetic cross sections. Through the choice of a suitable interaction potential it thus becomes possible to derive the temperature dependence of the viscosities of the two He isotopes near the absolute zero; it is possible to show that the differences between these two quantities is largely caused by the fact that the nuclei of He^3 and He^4 follow different statistics. The agreement between theory and experiment is not quite as satisfactory in the case of the viscosity of mixtures of the two isotopes. Finally, curves are presented showing the effect of symmetrization on various possible scattering experiments. (auth)

5702

ENERGY REQUIRED TO PRODUCE ONE ION PAIR FOR SEVERAL GASES. J. Weiss and W. Bernstein (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 98, 1828-31(1955) June 15.

The absolute values of W, the energy required to produce one ion pair, for electrons have been determined for several gases. A parallel plate extrapolation ionization chamber in conjunction with a ferrous sulfate dosimeter was used. The gases investigated were air, nitrogen, oxygen, carbon dioxide, argon, methane, and ethylene; and the absolute values of W were 33.9, 34.8, 30.9, 32.6, 25.5, 26.8, and 26.3 ev, respectively. (auth)

INSTRUMENTS

5703 NBS-4122

National Bureau of Standards. Office of Basic Instrumentation, Washington, D. C.
A JERKMETER FOR BALLISTOCARDIOGRAPHY. Thomas A. Perls and Charles W. Kissinger. June 1955. 21p.
Sponsored by ONR; OSR; and AEC under contracts NAord-21-48 and CS-640-55-9.

"Jerk" is defined as the time derivative of acceleration. Simple methods for designing jerkmeters are briefly discussed. The present design consists of a low-frequency (20 cps) piezoelectric accelerometer, the output of which is electrically differentiated. The response of the instrument is flat within ± 7% from zero frequency to 18 cps, at 21°C, but changes in response up to 33% are introduced in the range between 10 and 18 cps at temperatures between 12 and 32°C. A ballistocardiogram is shown, with simultaneous displacement, velocity, acceleration and jerk records. (auth)

5704 NP-5692

California. Univ., Berkeley. Microwave Lab.
A HIGH VOLTAGE, HIGH-SPEED SQUARE WAVE SURGE GENERATOR. D. H. Goodman, D. H. Sloan, and E. Trau. July 1, 1952. 20p. Contracts W-19-122-ac-38 and W-33-038-ac-16649.

The design principles of a surge generator, which delivers high-voltage square pulses of short time duration, are discussed. The generator has lumped constant transmission lines substituted for the condensers usually found in Marx type circuits and incorporates other changes which reduce the hash and jitter time of the device. Test results on an experimental model are given. Square pulses of 0.8 μsec duration are obtained in a matched load of 44 ohms at 80 kv. The rise time of the pulse is approximately 0.001 μsec and the jitter time of the system has been reduced to less than 0.01 μsec. The voltage amplitude of the generated pulse can be increased simply by the addition of more sections. (auth)

5705 NP-5698

Canada. Experimental Station, Suffield, Alberta.
VACUUM EVAPORATION APPARATUS—A NEW VACUUM VALVE AND AN ION GAUGE PROTECTIVE CIRCUIT. SUFFIELD TECHNICAL PAPER NO. 34. R. B. Harvey and F. L. McCallum. Feb. 4, 1954. 10p.

The construction and operation of a vacuum evaporation apparatus involving a novel vacuum valve of large diameter, and a protective circuit designed to reduce the danger of burning out the ionization gauge filament, are described. (auth)

5706

MINIATURE FLUORESCENT X-RAY SPECTROGRAPH. L. S. Birks and E. J. Brooks (Naval Research Lab., Washington, D. C.). Anal. Chem. 27, 1147-9(1955) July.

A simple, inexpensive x-ray spectrograph with no moving parts and with provision for recording the spectra from two specimens simultaneously, side by side, on photographic film is described. The instrument is about the size of a small x-ray powder diffraction camera and is used on ordinary x-ray diffraction-type equipment. Its main use is in qualitative and semiquantitative analysis, and it covers the same range of elements as the usual Geiger-counter, fluorescent, x-ray spectrometers. With exposure times of 0.5 to 1 hour, concentrations of 2% manganese in an iron matrix and of less than 0.5% manganese in an aluminum matrix may be detected. Resolution is good enough to separate manganese–Kα radiation at 2.10 A. from chromium–Kβ radiation at 2.08 A. (auth)

5707

LOCATION OF SYMMETRIC PEAKS BY A SIMPLE LEAST SQUARES METHOD. William S. Horton (Knolls Atomic Power Lab., Schenectady, N. Y.). Anal. Chem. 27, 1190-1 (1955) July.

A simple expression is developed for computing the location of a symmetric maximum or minimum in spectrometers. The expression, based on the orthogonal polynomial method of least squares, eliminates most of the intermediate work and markedly shortens the time for computation. The formula is derived for seven equally spaced intervals of the independent variable. (auth)

5708

NEW MULTICHANNEL RECORDING TIME-DELAY ANALYZER. P. G. Koontz (Wooster Coll., Ohio) and C. W. Johnstone, G. R. Keepin, Jr., and J. D. Gallagher (Los Alamos Scientific Lab., N. Mex.). Rev. Sci. Instr. 26, 546-54(1955) June.

A new time-delay analyzer encompassing a wide flexible time base is described. Time channels of 0.001, 0.01, 0.1, 1, and 10 sec width are provided; these may be combined in progressive sequence or used individually for essentially an infinite number of channels. Provision is made for either photographic or electric recording. Data obtained with the new analyzer agree with a conventional ten-channel time-delay analyzer over the limited range of the latter. A simple procedure is given for checking correct operation of the system. (auth)

5709

REFLECTED BEAM X-RAY MONOCHROMATOR FOR GEIGER COUNTER DIFFRACTOMETRY. Bani R. Banerjee (Standard Oil Co. of Indiana, Whiting). Rev. Sci. Instr. 26, 564-5(1955) June.

A bent crystal monochromator, for Geiger counter diffractometry, was constructed to monochromate the specimen-reflected x-ray beam. This results in very low backgrounds due to the elimination of fluorescent scattering from the specimen. Adequate resolution and diffracted energy were obtained. (auth)

5710

X-RAY DIFFRACTOMETER FOR HIGHLY RADIOACTIVE MATERIALS. M. A. Bredig, G. E. Klein, and B. S. Borie, Jr. (Oak Ridge National Lab., Tenn.). Rev. Sci. Instr. 26, 610(1955) June.

This instrument is based on a design previously described (Rev. Sci. Instr. 26, 5(1955)), but utilizes horizontal mounting of the x-ray tube, by which its line focus is brought into a position parallel with, rather than perpendicular to, the axis of the spectrogoniometer. Patterns of a pressed zirconia specimen before and after irradiation show little or no differences in background. (L.M.T.)

ISOTOPES

5711 NBS-4059

National Bureau of Standards, Washington, D. C.
BIBLIOGRAPHY ON THE ANALYSIS OF NITROGEN 15. M. W. Chapman and H. P. Broida. Progress Report to Atomic Energy Commission. [1954]. 40p.

This is a bibliography of the literature on N^{15} which has appeared through 1952 with a few later references. It covers the abundance of N^{15} naturally occurring and its physical properties, methods of concentrating it, methods of N^{15}/N^{14} measurement, and uses and synthesis of N^{15} compounds. (auth)

5712

PRODUCTION AND PHYSICAL PROPERTIES OF RADIOISOTOPES. C. J. Bakker (Univ. of Amsterdam). Rec. trav. chim. 74, 281-93(1955) May. (In English)

The production of radioisotopes in nuclear reactors and in cyclotrons is discussed. The types of nuclear reactions involved are mentioned. As to the production of radioisotopes, the cyclotron is an important complement to the nuclear reactor. Examples of disintegration schemes of radioisotopes are given. The loss of energy of β or γ rays during their passage through matter is briefly discussed. The precautions necessary when working with radioisotopes are mentioned shortly. (auth)

5713

THE DETERMINATION OF ISOTOPE RATIOS BY INFRARED GAS ANALYSIS. J. C. Kluyver. Rec. trav. chim. 74, 322-5(1955) May. (In English)

A new method is described for the determination of the abundance ratios of stable isotopes. The method is based on the difference in the infrared absorption spectra of isotopic molecules. The infrared isotope analyzer developed is a relatively simple instrument and succeeds in the measurement of the C^{13} abundance in 20 mg of CO_2 with an error of 0.005 at % C^{13} and the N^{15} abundance in 8 mg of NNO with an error of 0.015 at % N^{15} in the neighbourhood of the natural abundances of C^{13} and N^{15} respectively. (auth)

5714

SOME COMMENTS ON THE SPECIFIC HEAT OF LIQUID He^3. Ziro Mikura (Tohoku Univ., Sendai, Japan). Progr. Theoret. Phys. (Japan) 13, 120-2(1955) Jan.

It is concluded that temperature dependence of the specific heat of liquid He^3 in the temperature region 1.5°K to 2.5°K is probably due to thermal excitation of longitudinal Debye waves. (B.J.H.)

5715

ON THE SPECIFIC HEAT OF A SOLUTION OF He^3 IN LIQUID He^4. Ziro Mikura (Tohoku Univ., Sendai, Japan). Progr. Theoret. Phys. (Japan) 13, 122-3(1955) Jan.

Experimental and theoretical curves are given showing the temperature dependence of the specific heat of a 2.5% solution of He^3 in liquid He^4. Experimental data seem to justify the assumption that the He^3 atoms in this solution behave as a nondegenerate ideal gas below the λ point. (B.J.H.)

MATHEMATICS

5716 NACA-TN-3511
Lewis Flight Propulsion Lab., Cleveland.
EXTRAPOLATION TECHNIQUES APPLIED TO MATRIX METHODS IN NEUTRON DIFFUSION PROBLEMS. Robert R. McCready. [May 12, 1955]. 32p.

An iterative scheme is developed for the matrix solution of the type of characteristic-value problem arising from homogeneous linear equations. The scheme is shown to minimize a suitable form at each step. Extrapolation techniques for speeding convergence are developed and refined. An example from nuclear reactor theory is presented. (NACA Abst.)

5717 NBS-4108
National Bureau of Standards, Washington, D. C.
IMAGE PROCESSING. Leslie S. G. Kovasznay, Horace M. Joseph, and Nathan Newman. June 1955. 60p. Sponsored by ONR; OSR; and AEC under contracts NAonr-21-48 and CS-640-55-9.

A scalar function of two independent variables can be visualized as an image. Any mathematical operation can be regarded as a modification or processing of the original image. An important class of modifying operators can be realized by special scanning techniques without using a rapid access memory storage device. Two operators so far explored may have practical importance. One is contour enhancement which has "deblurring" effects akin to aperture correction and "crispening" in television practice; the other is contour outlining which produces a line drawing from a picture with continuous tones. The general concepts developed may also permit extension of the method to analogue computers for certain classes of partial differential equations. The flexibility and adaptability of the system offer practical application whenever some predetermined operation is required on picture material. (auth)

5718 NP-5701
Utah. Univ., Salt Lake City. Inst. of Rate Processes.
THE WAVE MECHANICAL PROBLEM OF THREE HYDROGEN ATOMS. TECHNICAL REPORT NO. 6. SOME QUANTUM MECHANICAL INTEGRALS. IV. TWO ELEMENTARY THREE PARAMETER INTEGRALS. (STUDIES IN APPLIED MATHEMATICS NO. 18). C. J. Thorne, R. S. Barker, and H. Eyring. Sept. 1, 1954. 308p. Contract DA-04-495-ORD-436.

A table of solutions of two integral functions which arise in the molecular quantum mechanical formulation of the energy of a triatomic hydrogen complex is presented. (For preceding report in this series see NP-5176.) (C.W.H.)

5719
CALCULATION OF GENERALIZED HYPERGEOMETRIC SERIES. Susie E. Atta and Ward C. Sangren (Oak Ridge National Lab., Tenn.). J. Assoc. Computing Machinery 1, 170-2(1954) Oct.

A subroutine has been programmed on the oracle for computing special mathematical functions which are easily expressed in the generalized hypergeometric function notation. (L.M.T.)

MEASURING INSTRUMENTS AND TECHNIQUES

5720 AECU-3040
Illinois Inst. of Tech., Chicago. Armour Research Foundation.
DETECTION OF AIR-BORNE BERYLLIUM DUST. MONTHLY REPORT NO. 3 COVERING THE PERIOD MAY 1 TO JUNE 1, 1955. R. G. McCarty and L. Reiffel. June 14, 1955. 5p. Contract AT(11-1)-346.

Progress is reported on the development of a radiometric Be hazard detector for use in air monitoring. A prototype γ-ray detecting system was assembled and data obtained on samples of Be salts on filter paper under a variety of conditions are presented. A block diagram of the system employed is included. (For preceding period see AECU-3027.) (C.H.)

5721 AECU-3045
Massachusetts Inst. of Tech., Cambridge.
RADIUM AND MESOTHORIUM POISONING AND DOSIMETRY AND INSTRUMENTATION TECHNIQUES IN APPLIED RADIOACTIVITY. ANNUAL PROGRESS REPORT. May 1955. 71p. Contract AT(30-1)-952.

5722 CRLR-218
Chemical and Radiological Labs., Army Chemical Center, Md.
A SIMPLIFIED PROCEDURE FOR REFILLING GEIGER MUELLER TUBES. Henry A. Garon. June 11, 1953. 13p.

The work was undertaken to prolong the life of the Geiger-Mueller tubes used in general counting work, and to adapt them for counting at higher altitudes. These tubes have an average life of approximately 10^9 counts, discounting shelf-life. The life while in use is rendered relatively short because of the continuous loss of alcohol by quenching while the tube is in use, and because of the possibility of initiating continuous discharge if a too high voltage is accidentally impressed. For these reasons, and also because a tube of this type may often be required when a replacement is not available, it is an advantage to have at hand a ready and inexpensive method for repairing and refilling discarded tubes. (auth)

5723 LA-1901
Los Alamos Scientific Lab., N. Mex.
GLOW TUBE SCALERS FOR TIMING APPLICATIONS. George LeCompte. July 5, 1955. 25p. Contract W-7405-eng-36.

A glow tube scaler suitable for constant-frequency counting up to 1000 cps is described. It offers reliability, low power consumption, flexibility of scaling factors, and ease of presetting. A sequential operation control circuit is described and examples of its use with glow tube scalers are given. Several instruments built by the Electronics Group using Type 5823 tubes and the above circuits are described. (auth)

5724 NRL-4571
Naval Research Lab., Washington, D. C.
A SIMPLE METER FOR RADIOACTIVE FALL OUT. [INTERIM REPORT]. C. C. Klick, H. Rabin, J. J. Lambe, H. J. Peake, and P. T. Cole. [June 7, 1955]. 8p.

A dose rate meter has been constructed using a battery, cadmium sulphide crystal, and parallel combination condenser and neon flash lamp. It is sensitive over the range of 0.1 to 1000 r/hr, is reasonably energy independent, has a flash rate proportional to gamma dose rate, and uses only commercially available components. (auth)

5725 AECL-181
CALCULATION OF THE ELECTRON-OPTICAL PARAMETERS OF THE β-SPECTROMETER WITH DOUBLE FOCUSSING OF THE ELECTRON BEAM. A. V. Zolotavin and V. S. Sadovsky. Translated from Izvest. Akad. Nauk S.S.S.R. Ser. Fiz. 18, 215-26(1954). 27p.

An abstract of this paper appears in Nuclear Science Abstracts as NSA 8-6349.

5726

TOTAL-BODY γ-RADIATION FROM PATIENTS WITH INTERNALLY DEPOSITED THORIUM. J. Rundo and Mogens Faber (Finsen Lab., Copenhagen, Denmark). Rec. trav. chim. 74, 416-22(1955) May. (In English)

The application of a total-body γ monitor using high-pressure ionisation chambers to the measurement of radiation from patients is described. Patients with internally deposited thorium have been studied. The interpretation of the measurements in relation to the amount of thorium present, the age of the deposits, the accumulation of daughter products and the distribution of the thorium in the body is discussed. (auth)

5727

ROUTINE ENERGY MEASUREMENTS OF SOFT RADIATIONS. M. L. Curtis and J. W. Heyd (Mound Lab., Miamisburg, Ohio). Anal. Chem. 27, 1073-6(1955) July.

Utilizing a windowless absorption counter and absorbers a method is described for the measurement of the energy of very soft radiation in the presence of hard emission in samples of low total activity. (C.W.H.)

5728

VOLTAGE-DEPENDENCE OF ELECTROLUMINESCENT BRIGHTNESS. I. DIELECTRIC-IMBEDDED PHOSPHORS. F. A. Schwertz, J. J. Mazenko, and E. R. Michalik (Mellon Inst., Pittsburgh). Phys. Rev. 98, 1133-4(1955) May 15.

The brightness of seven electroluminescent phosphors was measured as a function of voltage and frequency. The data were compared to that obtained from three empirical equations. (B.J.H.)

5729

VOLTAGE DEPENDENCE OF ELECTROLUMINESCENT BRIGHTNESS. II. CHEMICALLY DEPOSITED PHOSPHOR FILMS. F. A. Schwertz and R. E. Freund (Mellon Inst., Pittsburgh). Phys. Rev. 98, 1134(1955) May 15.

The electroluminescent brightness of a $\mathrm{ZnS:Mn}$ film was studied as a function of voltage. The data were found to conform to that of an empirical equation. (B.J.H.)

5730

INTERMEDIATE IMAGE FOCUSING IN COINCIDENCE BETA-RAY SPECTROMETERS. Hilding Slätis and Carl Johan Herrlander (Nobel Inst. of Physics, Stockholm, Sweden). Rev. Sci. Instr. 26, 613-14(1955) June.

High transmission with good resolution is obtained in coincidence β spectrometers by employing the intermediate image focusing principle. The iron yoke is changed to enable placing the sample outside the yoke. The form of yoke employed in this case effectively prevents the magnetic field of one spectrometer from disturbing the field in the other. Such an instrument is under construction at the Nobel Institute of Physics. (L.M.T.)

5731

BRITISH RADIAC INSTRUMENTATION. SOME RECENT TRENDS. Denis Taylor and W. Abson (Atomic Energy Research Establishment, Harwell, Berks, England). Atomics 6, 158-70(1955) June.

5732

SCATTERING MEASUREMENTS IN NUCLEAR EMULSIONS AND THEIR APPLICATION TO MEASURING THE CHARGE OF PRIMARY COSMIC RAY NUCLEI. S. Biswas, B. Peters, and Rama (Tata Inst. of Fundamental Research, Bombay, India). Proc. Indian Acad. Sci. A41, 154-84(1955) Apr.

Small local dislocations in processed emulsions give rise to spurious scattering whose effect on tracks is indistinguishable from the multiple scattering produced by coulomb interaction. Because of this effect the atomic number of fast primary cosmic ray nuclei will be underestimated in more than 50% of the cases in experiments where multiple scattering of tracks and ionization measurements are employed for charge determination. The spurious scattering was investigated by measuring the track contours of 100 very long tracks due to energetic primary particles; the effect was present in comparable strength in all plates and all types of emulsions which have been investigated. It is too small to affect measurements on medium energy particle tracks (protons with energy below 600 Mev and heavy nuclei with energy below 300 Mev/nucleon). It dominates, however, other sources of error and noise for tracks of energetic particles although it does not preclude occasional observations of very low scattering values. New methods for measuring various forms of noise have also been developed in the course of this work and the noise level for scattering measurements has been reduced below previously accepted values. Spurious scattering is presumably largely responsible for the discrepancies which appear when one compares the primary charge and energy spectra derived from experiments involving scattering measurements with the corresponding spectra derived from numerous other experiments which employ different techniques. If the experiments based on scattering measurements are omitted, the remaining evidence strongly favors a spectrum in which the energy per nucleon is nearly independent of atomic number for all primaries. It also favors a charge distribution which has a pronounced minimum for charges $3 \leq Z \leq 5$ and, therefore, yields a fairly low upper limit for the amount of interstellar matter traversed by primary cosmic ray nuclei. (auth)

5733

ON A METHOD OF KNOCK-ON ELECTRONS FOR THE DETERMINATION OF THE MASS OF PARTICLES OF MINIMUM IONIZATION. A. De Marco, A. Milone, and M. Reinharz (Univ. of Genoa, Italy). Nuovo cimento (10) 1, 1041-56(1955) June. (In Italian)

A method has been studied for the determination of the mass of minimum ionization particles in nuclear emulsions, in the case in which a knock-on electron is generated. In using the conservation theorems for energy and momentum, one can determinate a function of the velocity of the particles, which is sensitive to variation of the velocity. Criteria have been given for the recognition of the knock-on electrons, and the various errors which influence the measurements of the energy and the angle of emission have been examined. The error on the determination of the mass of the incident particle has been calculated. An analysis of the distribution of the experimental values shows that the errors calculated according to criteria given by us, agree quite well with the experimental ones. Taking into account the frequency of these knock-on electrons, the limitations of this method as well as its possible application in the case of single events or in a systematic study of the isotopic composition of the primary cosmic radiation are discussed. (auth)

5734

SPURIOUS PEAKS DUE TO MULTIPLE BACKSCATTERING IN A SINGLE CRYSTAL GAMMA SPECTROMETER. A. Bisi and L. Zappa. Nuovo cimento (10) 1, 1120-5(1955) June. (In English)

The energy spectra obtained with a single crystal spectrometer for γ rays have been investigated in detail in the energy range between 50 and 300 kev. Several γ sources have been used. Evidence is given of some effects due to back-scattering of γ rays from the materials surrounding the crystal. The influence of these effects upon the reliability of the spectrometer in the considered interval of energy is discussed. (auth)

5735

A METHOD FOR STRIPPING NUCLEAR EMULSIONS FROM THEIR GLASS SUPPORTS AND REMOUNTING THEM. C. Dahanayake (Univ. of Bristol, England). Nuovo cimento (10) 1, 1254-4(1955) June. (In English)

A method for stripping nuclear emulsions from their glass supports and remounting them is described. The stripping is effected by immersing the plate in a weak solution of hydrofluoric acid in sodium acetate buffer. After careful washing the remounting is carried out as in the case of new stripped emulsions. (auth)

5736

A GAS MIXTURE FOR FILLING FAST IONIZATION CHAMBERS, INSENSITIVE TO OXYGEN CONTAMINATION. U. Facchini and A. Malvicini (CISE Lab., Milan Italy). Nuovo cimento (10) 1, 1255-60(1955) June. (In Italian)

Gridded ionization chambers using electron collection, while very precise instruments for measuring the energy of α particles, are not well suited to quick operation. The filling gas must be freed of even a trace of electron-capturing gas or vapor. This requires careful evacuation of the chamber and prolonged purification of the filling gas. In contrast, mixtures of A and 2 ÷ 4% N_2 give good counting characteristics with up to 0.5% O_2, much more O_2 than is found in commercially available supplies. No very special precautions need to taken. Thus α-particle spectra of short-lived emitters can be readily measured. Analysis of α-emitting nuclides contained in air is possible. (auth)

5737

ON THE SENSITIVE VOLUME OF GEIGER-MUELLER COUNTERS WITH EXTERNAL CATHODE. D. Blanc (College of France, Paris). Nuovo cimento (10) 1, 1280-1(1955) June. (In French)

An analysis is made of the size of the sensitive volume of Geiger-Mueller tube with external cathode. For glass envelopes made of UVK-1 and UVK-2, and internal diameters of 0.5 to 3 cm, the effective length of the sensitive volume $L = L_c + 0.2L_i$, where L_c is the length of the cathode, and L_i is the volume length minus the cathode length. (K.S.)

5738

ČERENKOV COUNTERS WITH THIN LUCITE RADIATORS. John Linsley and Nahmin Horwitz (Univ. of Minnesota, Minneapolis). Rev. Sci. Instr. 26, 557-60(1955) June.

Cherenkov counters are described which have been used successfully in measurements of the flux of primary cosmic-ray alpha particles. They consist of cylindrical lucite radiators 2.5 cm thick viewed by end-window photomultipliers. Fast singly charged particles that pass through the effective area in directions roughly parallel to the counter axis give pulse-height distributions with 35 to 45% relative width at half-maximum for effective areas up to 60 cm^2. An analysis of factors that influence the resolution of Cherenkov counters is given. (auth)

MESONS

5739 NEVIS-12

Columbia Univ., Irvington-on-Hudson, N. Y. Nevis Cyclotron Labs.

A DIFFUSION CHAMBER STUDY OF VERY SLOW MESONS: III. SCATTERING OF NEGATIVE PIONS IN HYDROGEN. M. C. Rinehart, K. C. Rogers, and L. M. Lederman. June 1955. 16p. Sponsored by ONR and AEC under Contract N6-ori-110, Task No. 1. (CU-86-55-ONR-110-1-Phys.)

The elastic scattering in hydrogen of negative pions near 15 Mev is studied. In a path length represented by 8300 π-μ decays, 26 events were observed. At these low energies, the S wave dominates the scattering. Treating the small P-wave and large coulomb contributions as known, the data are found to be well represented by an S-wave phase shift proportional to momentum. Under this assumption, the phase shift parameters are given by the relation: $\alpha_3 + 2\alpha_1 = (0.25 \pm 0.05)p/\mu c$ in radians. (auth)

5740

ON STAR PRODUCTION BY μ-MESONS UNDERGROUND. G. N. Fowler (Univ. of Manchester, England). Proc. Phys. Soc. (London) A68, 482-8(1955) June.

The application of Williams' method to underground star production by μ mesons is discussed. It is shown that the virtual photon spectrum derived by Williams is not applicable to this process and the appropriate virtual photon spectrum is deduced. The results on star production are then re-examined and it is shown that photonuclear effects are unable to explain the observed cross sections. The relationship of this result to the observations on the anomalous scattering of μ mesons is also discussed. (auth)

5741

THE PRODUCTION OF HYPERONS AND HEAVY MESONS. G. D. James and R. A. Salmeron (Univ. of Manchester, England). Phil. Mag. (7) 46, 571-86(1955) June.

A full dynamical analysis of the reaction $\pi \times N \rightarrow Y + K$ is given and it is shown that some of the results apply to the production of hyperons in any collision with a free nucleon at rest. In particular, difficulty is found in accounting for the low-energy hyperons that are frequently observed in both cloud chambers and photographic emulsion. Their existence necessitates a mechanism by which hyperons can lose most of their energy. It is suggested that this process is scattering by nucleons. 19 cloud chamber photographs showing two V events associated with the same nuclear interaction are discussed. In no case do the V events represent the decays of the two secondaries of reaction (1). The observed frequency of associated V events provides no evidence for or against the hypothesis that heavy unstable particles are always produced in the above reaction or in similar 'double production' reactions. Because the secondary particles from these reactions are scattered in heavy nuclei it is concluded that the reactions can best be studied in light materials. (auth)

5742

PRODUCTION OF π° MESONS BY NEUTRONS. B. M. Pontecorvo and G. I. Selivanov (Inst. of Nuclear Problems). Doklady Akad. Nauk S.S.S.R. 102, 253-6(1955) May 11. (In Russian)

Be, C, Al, Fe, Cu, Sn, and Pb were exposed to neutrons of 400 Mev nominal energy produced by synchrocyclotron proton bombardment of Be. Relative cross sections for π°

meson production were measured. The variation with atomic mass is discussed. (G.Y.)

5743

PRODUCTION OF π^0 MESONS ON HYDROGEN AND DEUTERIUM BY NEUTRONS OF 400 MEV ENERGY. B. M. Pontecorvo and G. I. Selivanov (Inst. of Nuclear Problems). Doklady Akad. Nauk S.S.S.R. 102, 495-7(1955) May 21. (In Russian)

5744

UNSTABLE HEAVY PARTICLES IN NUCLEAR EMULSIONS. M. Baldo, G. Belliboni, M. Ceccarelli, M. Grilli B. Sechi, B. Vitale, and G. T. Zorn (Univ. of Padova, Italy). Nuovo cimento (10) 1, 1180-1210(1955) June. (In Italian)

A systematic investigation of heavy unstable particles has been carried out at the University of Padua using two stacks of 40-Ilford G5 nuclear research stripped emulsions each 600 μ thick, exposed at balloon altitudes. A summary of the events observed during the first scanning as well as those found during the systematic re-examination is given. A detailed analysis of all unstable particle events was made. For particles whose ranges terminated in the emulsion, the mass values were obtained from scattering measurements applying both the method of constant sagitta and a method similar to the P method of the Bristol group, as well as the method of comparative grain densities based on measurements of specific ionization. The masses of those particles which did not come to the end of their ranges in the emulsion were determined from measurements of multiple scattering and specific ionization. These mass values were based on calibration curves determined for particles of known mass and charge. 12 K_1 mesons decaying at rest have been observed. An average mass value of 985 ± 30 m_e has been obtained and the mass distribution about this mean is consistent with a unique mass value for all K_1 particles observed. In four of the events the minimum secondary particles were emitted at very small angles with respect to the emulsion plane. It would seem that 3 of the events could be satisfactorily explained by the scheme: $K^{\pm}_{\pi 2} \rightarrow \pi^{\pm} + \pi^0 + Q$. Using for the $p\beta$ of the secondary particle the value of 163 ± 7 Mev/c, and for the primary mass a value of 962 ± 38 m_e, and applying the momentum laws, we have calculated the mass of the neutral secondary to be 296 ± 60 m_e. Six τ mesons decaying at rest have been observed in this investigation; three of the τ events are complete and were produced by a positively charged primary. The average value for the Q is 75.4 ± 0.4 Mev, which corresponds to a mass of 967 ± 0.8 m_e. In another event a K-particle comes to rest in the emulsion layers and decays into a single positive pion of 6 Mev. This event has also been interpreted as the decay of a τ meson. In the search for Λ^0, 292 negative pions were followed back, four of them being observed to come from stars in which only one other charged particle was involved. Three of these two prong stars seem to have been produced by the decay in flight of a neutral hyperon according to the scheme: $\Lambda^0 \rightarrow \pi^- + p + 37$ Mev. Four decays of charged hyperons have been observed. Five clear examples of the delayed disintegration of a heavy fragment emitted from a nuclear disintegration have been observed. In one of these events the disintegration of a He nucleus is accompanied by the emission of a negative pion and has been interpreted as being the result of the mesonic decay of a Λ^0 particle, whose binding energy has been calculated to be 1.7 Mev. In another event we are dealing with the disintegration of a probable T nucleus, with the emission of a 40.3-Mev π meson and a 2.5-Mev He nucleus. For this event the binding energy of the Λ^0 is found to be less than 1 Mev. The stars from which K-particles are emitted generally exhibit a rather low multiplicity: we are therefore led to the conclusion that K meson production at primary energies of less than 5 bev is an important phenomenon. (auth)

5745

EVIDENCE FOR THE K_μ-MESON. J. K. Bøggild, J. E. Hooper, W. C. G. Ortel, and M. Scharff (Univ. of Copenhagen, Denmark). Nuovo cimento (10) 1, 1267-8(1955) June. (In English)

Five events in a stack of stripped emulsions have been observed that are similar to the K_μ events previously reported by the Pic-du-Midi group. A number of secondary particles were found to have nearly identical $p\beta c = 226 \pm 7$ Mev. It is concluded that these secondaries are L mesons. The mean of three primary mass measurements is 981 ± 23 M_e. By assuming a decay $K \rightarrow \mu + \nu$, a primary mass of 1004 ± 20 M_e is obtained, on good agreement with that obtained by direct measurement. (K.S.)

5746

ON THE PLURAL-MULTIPLE MODEL OF HIGH ENERGY MESON SHOWERS. Yoshinosuke Terashima (Kyoto Univ., Japan). Progr. Theoret. Phys. (Japan) 13, 1-12(1955) Jan.

The internuclear cascade on the basis of the multiple theory of meson production is investigated in view of the so-called cosmic ray jet. The implication of Fermi's and Heisenberg's theories in this picture of the cascade is discussed purely on the kinematical ground. The predominant role in meson production of the successive collisions is played by the many-body collisions in the case of Fermi's theory, while by the simple nucleon-nucleon collision in Heisenberg's. The tunnel approximation of jets is shown to be applicable in these cases at sufficiently high energies. The criterion of this approximation is given by calculating the number of mesons which get off the tunnel. The possibility of accompanying grey tracks besides evaporation particles arises from these low energy mesons. The anisotropy in the angular distribution of jet particles, is shown to be stronger in Fermi's model than in Heisenberg's model. The present experimental evidences are too meager to choose one of these theories, but seem preferable to Fermi's theory rather than to Heisenberg's. (auth)

5747

SPIN-ORBIT COUPLING IN THE PSEUDOSCALAR MESON THEORY OF NUCLEAR FORCES. Gentaro Araki (Institut Henri Poincare, Paris). Progr. Theoret. Phys. (Japan) 13, 13-18(1955) Jan.

The fourth order nuclear forces were derived by Sato on the basis of the pseudoscalar meson theory. The spin-orbit coupling contained in his result is examined in the approximate way. The doublet interval $^2D_{3/2} - {}^2D_{5/2}$ of the O^{17} nucleus due to this spin-orbit coupling is calculated taking into account all spin-orbit couplings between seventeen nucleons according to the method of Talmi. The result contains a divergent integral. If we make it converge by a suitable device we have the interval value of nearly 5 Mev. (the observed value is 5.08 Mev). The theoretical result on the same assumption is too large compared with experiment in case of He^5 and Li^5. (auth)

5748

ON FERMI'S THEORY OF MULTIPLE PRODUCTION. Ken-ichi Ono and Kei Yokoi (Univ. of Tokyo). Progr. Theoret. Phys. (Japan) 13, 101-2(1955) Jan.

A discussion is given to the quantity to be used as the volume of the total system giving rise to multiple meson production. It is concluded that it is plausible to assume a real volume larger than that used in the Fermi theory. (B.J.H.)

5749

A TENTATIVE ANALYSIS OF $\pi - 2\pi$ PROCESS. Daisuke Ito and Shigeo Minami (Tokyo Univ. of Education and Osaka City Univ., Japan). Progr. Theoret. Phys. (Japan) 13, 108-9(1955) Jan.

The production ratio of pions in meson-nucleon reactions is analyzed and the numbers of observed events of this type are tabulated. Cross sections for the events are estimated. The role played by L-S coupling in such meson production is discussed. (B.J.H.)

5750

ON DOUBLE PION PRODUCTION IN NUCLEON-NUCLEON COLLISION. Daisuke Ito (Tokyo Univ. of Education). Progr. Theoret. Phys. (Japan) 13, 123-4(1955) Jan.

The angular distribution and energy spectrum of doubly produced mesons in nucleon-nucleon collisions are calculated. Results are compared to experimental results. (B.J.H.)

MOLECULAR PROPERTIES

5751

ENERGIES OF THE GROUND STATES OF He, Li$^+$, AND O^{6+}. S. Chandrasekhar (Univ. of Chicago, Ill.) and G. Herzeberg (National Research Council, Ottawa, Canada). Phys. Rev. 98, 1050-4(1955) May 15.

A complete 14-parameter calculation for the ground state of He and similar 10-parameter calculations for the ground states of Li$^+$ and O^{6+} have been carried out. In addition, using the four most important of eleven terms, which were tried individually as fifteenth parameters, an 18-parameter calculation for He has been carried out but without minimizing against the scale parameter k. Similar 12-parameter calculations were carried out for Li$^+$ and O^{6+} using the two most important terms beyond the tenth in the He calculation. As a result, the 18-parameter nonrelativistic ionization potential of He is found to be 198311.4 cm^{-1}. The series of 6, 10, 14, 18 parameter values appears to converge to $198312._3$ cm^{-1} with an error of less than 2 cm^{-1}. Adding the relativistic corrections yields $198310._4$ cm^{-1} which agrees to 0.1 cm^{-1} with the latest experimental value. Considering the uncertainties of the theoretical and experimental values, the magnitude of the Lamb shift of the ground state of He (compared to He$^+$) must be less than 3 cm^{-1} which does not contradict present theoretical estimates. Similar agreements but within wider limits of error are found for the 12-parameter energy values of the ground states of Li$^+$ and O^{6+}. (auth)

5752

MOLECULAR CONSTANTS AND NUCLEAR-MOLECULAR INTERACTIONS OF Li^{7}F^{19} BY THE MOLECULAR BEAM ELECTRIC RESONANCE METHOD. R. Braunstein and J. W. Trischka (Syracuse Univ., N. Y.). Phys. Rev. 98, 1092-8(1955) May 15.

The electric resonance method of molecular beam spectroscopy was used to observe the Li^{7}F^{19} spectra arising from transitions of the type $(J,m_J) \rightarrow J,m_{J'})$. Data were taken for the $(1, 0) \rightarrow (1, \pm 1)$ and $(2, 0) \rightarrow (2, \pm 2)$ transitions for the $v = 0$ and $v = 1$ vibrational states. The latter transitions were observed by a double-quantum process which occurs by the absorption or stimulated emission of two quanta. From the analysis of the hyperfine structure, the signs and magnitudes of the Li^7 electric quadrupole constant, (eqQ), the F^{19} and Li^7 spin-rotation constant $c_{F^{19}}$ and c_{Li^7} respectively, and the nuclear dipole-dipole interaction, $g_1g_2(\mu N)^2/r^3h$, were determined. The internuclear distance was determined from the latter constant. (μ^2A) was determined from the strong-field data, where μ is the permanent electric dipole moment and A is the moment of inertia. The dipole moment was then calculated from (μ^2A) and the internuclear distance. (auth)

5753

COLLISION ALIGNMENT OF MOLECULES, ATOMS, AND NUCLEI. Norman F. Ramsey (Clarendon Lab., Oxford, England and Harvard Univ., Cambridge, Mass.). Phys. Rev. 98, 1853-4(1955) June 15.

Alignment of particles can be achieved in a transmitted beam attenuated by a scattering vapor if the particle spin is greater than $\frac{1}{2}$. With beams of linear molecules attenuated by a monatomic scattering vapor whose kinetic velocities are considerably less than those of the molecular beam, factors of 2 or more in cross section may exist between $M_J = 0$ and $M_J = \pm J$ states. Collision alignment should also be achieved for atoms in electron P or higher states and for nuclear particles of spin greater than $\frac{1}{2}$. Applications and methods for detecting collision alignment are discussed. (M.P.G.)

NEUTRONS

5754

ON THE ELECTRON-NEUTRON INTERACTION. Masami Yamada (Univ. of Tokyo). Progr. Theoret. Phys. (Japan) 13, 124-6(1955) Jan.

The strength of the electron-neutron interaction is calculated. Special attention is given to that part of the interaction which depends on the interaction between nucleon and magnetic field. (B.J.H.)

NUCLEAR PHYSICS

5755 ISC-608

Ames Lab., Ames, Iowa.

QUARTERLY SUMMARY RESEARCH REPORT IN PHYSICS FOR JANUARY, FEBRUARY, AND MARCH 1955. July 5, 1955. 8p. Contract W-7405-eng-82.

Data are given on the ionization yield of protons in argon; the beta spectra of Si^{27}, P^{29}, S^{31}, and Ca^{39}; and the electrical properties of Mg$_2$Si. Work is also being done on a meter to be used in the measurement of magnetic field gradients for high energy accelerators and on properties of thin sodium films. (B.J.H.)

5756

NEW METHOD FOR THE SOLUTION OF THE DEUTERON PROBLEM AND ITS APPLICATION TO A REGULAR POTENTIAL. F. Cap and W. Grobner (Innsbruck Univ., Austria). Nuovo cimento (10) 1, 1211-22(1955) June. (In English)

First, success and failure of the usual linear charged PS meson theory of nuclear forces are discussed, and reasons given for nonlinear terms yielding finite potentials. Second, a new method of solution of the deuteron problem is given and applied to a regular PS potential. It is shown that the discussed nonlinear PS theory yields far better results for the deuteron than the linear theory. (auth)

5757

A NOTE ON NUCLEAR TEMPERATURES AT LOW EXCITATION ENERGIES. D. L. Livesey (Queen's Univ., Kingston, Ontario, Canada). Can. J. Phys. 33, 391-3(1955) July.

The suggestion is made that a number of experimental data concerning nuclear level densities can be unified, providing that constant nuclear temperature at low excitation energies is hypothesized. Examples are given, and it is concluded that this hypothesis is more satisfactory than treatments based solely on the Fermi-Dirac gas formula. (B.J.H.)

5758

MATRIX TREATMENT OF NUCLEAR INDUCTION. E. T. Jaynes (Stanford Univ., Calif.). Phys. Rev. 98, 1099-1105 (1955) May 15.

By use of matrix notation, solutions of the Bloch equations may be kept in simple, manageable form even in the case of applied fields that are complicated functions of time. Effects that from the usual standpoint are grossly nonlinear appear as linear relations between matrices, of the same form that one encounters in simple radioactive decay problems. A general property of transients in the case of an arbitrary repetitive applied signal is established, and a formalism is set up in terms of which a large class of special problems may be solved. (auth)

5759

NUCLEAR INDUCTION IN INHOMOGENEOUS FIELDS. Arnold L. Bloom (Varian Associates, Palo Alto, Calif.). Phys. Rev. 98, 1105-11(1955) May 15.

The mathematical methods developed by Jaynes are applied to the study of nuclear resonance in inhomogeneous magnetic fields. It is shown that a description of delayed-signal phenomena such as spin echoes is greatly simplified by the use of the spinor representation involving 2 × 2 transformation matrices. The original results of Hahn on spin echoes are rederived in simplified fashion and more complicated situations are discussed, including large numbers of pulses, exact time dependence in extremely inhomogeneous fields, and continuous pulse trains. Several previously unreported types of delayed-signal phenomena are discussed and illustrated experimentally by oscilloscope traces. The apparatus used to study nuclear induction in very inhomogeneous fields is briefly discussed. (auth)

5760

OVERHAUSER NUCLEAR POLARIZATION EFFECT. W. A. Barker and A. Mencher (Swiss Federal Inst. of Tech., Zurich, Switzerland). Phys. Rev. 98, 1868-9(1955) June 15.

Thermodynamic and perturbation theories are applied to a system in which nuclear spin relaxation may occur by any or all of three processes. Resulting equations for the degree of nuclear polarization attained are given. (B.J.H.)

5761

A SEARCH FOR CAPTURE PROCESSES IN ALPHA-PARTICLE AND DEUTERON BOMBARDMENTS. H. R. Allan and N. Sarma (Imperial Coll., London). Proc. Phys. Soc. (London) A68, 535-8(1955) June.

An attempt was made to detect alpha-particle and deuteron capture by various targets. Scintillation counter, threshold, and induced radioactivity detection methods were used. No definite evidence for the process was found. (B.J.H.)

NUCLEAR PROPERTIES

5762 BNL-221

Brookhaven National Lab., Upton, N. Y.
EFFECT OF RECENT CROSS-SECTION MEASUREMENTS ON PILE CONSTANTS. J. A. Harvey and D. J. Hughes. Jan. 26, 1953. Decl. July 12, 1955. 12p.

A critical re-evaluation of important reactor constants is presented in view of the fact that several recent neutron cross section measurements to 1% accuracy have resulted in changes of the order of several per cent in the previously accepted values. The new cross sections as well as the resulting changes in useful reactor constants are given for U, U^{233}, U^{235}, U^{238}, Pu^{239}, and Pu^{241}. In addition, the new neutron absorption cross section values of B, Li, and Au which were used in the calculations are listed. (L.M.T.)

5763

STUDIES ON THE α-PARTICLE MODEL OF NUCLEI. I. A. Herzenberg (Univ. of Manchester). Nuovo cimento (10) 1, 986-1007(1955) June. (In English)

The kinetic energies of the $A = 4n$ nuclei (with $Z = N = 2n$) up to $A = 40$ are estimated on the basis of the α-particle model. This estimate is used, together with known regularities in the binding energies and an estimate of the Coulomb energy, to show that, on this model, there must be an additive attractive interaction between neighbouring α particles. New physical criteria are given for the stability of the α particles, and the degree to which their motion is adiabatic; the relevant parameters are estimated by the use of quantum mechanics. A comparison is made with the analogous situation in molecules. (auth)

5764

STUDIES ON THE A-PARTICLE MODEL OF NUCLEI. II. A. Herzenberg (Univ. of Manchester). Nuovo cimento (10) 1, 1008-40(1955) June. (In English)

A formalism for the interaction of α particles in nuclei is developed in an analogous way to the treatment of the interaction of atoms. The effective forces can be separated into a direct interaction (analogous to the long range coulomb interaction of ions), a nucleon exchange interaction (analogous to electron exchange), and a polarization interaction (analogous to van der Waals forces). The direct interaction is additive and independent of velocity. The nucleon exchange interaction is velocity dependent and not additive. The polarization interaction is velocity dependent, and whether or not it is additive is determined by the spin and charge dependence of the nuclear potential. The transition of the formalism to the usual treatment of atomic van der Waals forces is traced. Retardation effects due to the wave nature of the nuclear force field are unlikely to be present. It is shown that the asymptotic form of the forces between two α's with a Yukawa π-meson potential contains exponential factors $\exp[-s/1.4]$ (direct), $\exp[-s/0.7]$ (polarization), and $\exp[-s/0.6]$ (exchange), where s is the separation of the mass centers in units of 10^{-13} cm. Arguments are given against the conclusion from earlier work that α clusters in nuclear matter would dissolve. (auth)

5765

COULOMB INTERFERENCE IN THE PION-PROTON SCATTERING AT 120 MEV. L. Ferretti, E. Manaresi, G. Puppi and A. Ranzi (Univ. of Bologna, Italy) and G. Quareni (Univ. of Padova, Italy). Nuovo cimento (10) 1, 1238-50(1955) June. (In English)

A complete angular distribution for the positive pion-proton elastic scattering at 120 Mev is presented. The angular distribution deals with angles in the c.m. system between 15 and 180°, and is based on 545 events found in p.p. The analysis of the differential cross section for angles > 30° gives as phase shifts for the partial waves, $p_{3/2}$, $p_{1/2}$: $\alpha_3 = \mp 12.2°$, $\alpha_{33} = \pm 31.4°$, $\alpha_{31} = \mp 1.5°$. The choice of the sign of the phase shifts is based on the frequency of the events in the angular interval 15 to 30°. The present experiment gives evidence for the upper system of signs: the relative probability of the two systems of signs being 18. (auth)

5766

SADDLE SHAPES, THRESHOLD ENERGIES AND FISSION ASYMMETRY ON THE LIQUID DROP MODEL. U. L. Businaro and S. Gallone (CISE Lab., Milan, Italy). Nuovo cimento (10) 1, 1277-9(1955) June. (In English)

A previously derived formula for the deformation energy of the nuclear drop is considered for a prolated ellipsoid of revolution. The droplet shape is described by a Legendre expansion of the type $r(\mu) = a(1 + \Sigma\alpha_i P_i(\mu))$. The effect of P_2 deformation in fisson energy is considered for nuclei with $x < 0.9$. A contour plot of the energy surface $\Delta E/E_s$ in the (α, α_2) plane was drawn, and it is concluded that the liquid drop model may provide a satisfactory interpretation of asymmetric fission. (K.S.)

5767

COLLECTIVE ASPECTS OF NUCLEAR PHOTOEFFECT. U. L. Businaro and S. Gallone (CISE Lab., Milan, Italy). Nuovo cimento (10) 1, 1285-8(1955) June. (In English)

5768

THE ACTION OF A ROTATING MAGNETIC FIELD ON THE RESONANCE OF A SPIN SYSTEM. Joseph Seiden. Compt. rend. 240, 2228-30(1955) June 6. (In French)

5769

THE TIME T_2 IN THE NUCLEAR MAGNETIC RESONANCE OF LIQUIDS. Yves Ayant. Compt. rend. 240, 2230-3(1955) June 6. (In French)

5770

THE CONTINUOUS ATOMIC ABSORPTION CROSS SECTIONS FOR NEUTRAL ATOMIC SYSTEMS. G. V. Marr (Univ. of Reading, England). Proc. Phys. Soc. (London) A68, 544-6(1955) June.

Experimental data on the absorption cross section for photoionization of various atoms have been assembled. Various curves have been drawn for elements of similar configuration using these data. It is concluded that the cross sections for elements of large atomic number may be estimated from these curves. (B.J.H.)

5771

NUCLEAR SPIN RELAXATION IN ALKALI METALS. D. F. Holcomb and R. E. Norberg (Univ. of Illinois, Urbana). Phys. Rev. 98, 1074-91(1955) May 15.

Nuclear magnetic resonance measurements have been made in metallic lithium, sodium, and rubidium, using pulsed radio-frequency power. The experimental data are values of T_1, the spin-lattice relaxation time, and of T_2, the inverse line width or spin-spin relaxation time. Measurements were made at several Larmor frequencies and at temperatures between −65°C and 250°C. Over a considerable temperature range, T_1 is found to be primarily determined by interaction with the conduction electrons. The magnitudes of T_1 agree fairly well with the Korringa theory in all three metals. The lithium data in particular indicate that $P_f/P_a \cong 0.6$. In lithium and sodium a dependence of T_1 on the resonance frequency is observed, which cannot be explained on the basis of the Korringa theory. Information about the atomic self-diffusion process is also obtained. Portions of the T_1 and T_2 data are interpreted using the theory of Bloembergen, Purcell, and Pound. In addition, some of the T_1 data are interpreted in terms of the lattice diffusion theory of Torrey. These analyses yield values for D, the coefficient of self-diffusion, of $0.24^{+0.17}_{-0.10} \times \exp(-13,200 \pm 400/RT)$ cm^2/sec in lithium and $0.20^{+0.56}_{-0.15} \times \exp(-10,000 \pm 600/RT)$ cm^2/sec in sodium. Although there is some ambiguity in the interpretation of the rubidium data, they indicate $D \cong 0.23 \exp(-9400/RT)$ cm^2/sec. Unusual broadenings of the resonance lines are observed at the melting points in all three metals. These broadenings are not presently understood, but some features of the data can be correlated with a mechanism involving magnetic local fields which arise from lattice imperfections. (auth)

5772

OVERHAUSER EFFECT IN NONMETALS. A. Abragam (Centre d'Etudes Nucléaires de Saclay, Gif Sur Yvette, Seine et Oise, France). Phys. Rev. 98, 1729-35(1955) June 15.

A survey is made of different ways in which nuclear spins can relax through their interaction with electronic spins. It is shown that the maximum amount of nuclear polarization which can be obtained by saturating the electronic resonance depends: (a) on the type of interaction between electronic and nuclear spins, namely dipole-dipole type, scalar product type, or any combination of the two; (b) on the mechanism whereby the "lattice" provides the energy for the relaxation. The case of a nucleus belonging to a paramagnetic ion is examined in some detail with reference to the recent experiment of Honig on arsenic-doped silicon. It is shown that while an Overhauser effect may be expected, this offers no support for an interpretation of Honig's results as a 100% nuclear polarization. (auth)

5773

OVERHAUSER NUCLEAR POLARIZATION EFFECT AND MINIMUM ENTROPY PRODUCTION. Martin J. Klein (Case Inst. of Tech., Cleveland). Phys. Rev. 98, 1736-9(1955) June 15.

This paper gives a simple set of kinetic equations which describe the Overhauser method of producing nuclear polarization by saturating the electronic spin resonance. It is shown that thermodynamically the process consists of absorption of microwave energy and its conversion into heat. In the steady state this process satisfies the principle of minimum entropy production. (auth)

5774

NUCLEAR MAGNETIC RESONANCE SATURATION AND ROTARY SATURATION IN SOLIDS. Alfred G. Redfield (Harvard Univ., Cambridge, Mass.). Phys. Rev. 98, 1787-1809(1955) June 15.

Nuclear spin lattice relaxation times of Al^{27} in pure Al and Cu^{63} in annealed pure Cu were measured with a nuclear spectrometer, by the method of saturation. The experimental values of T_1 are 4.1 ± 0.8 msec for Al^{27} and 3.0 ± 0.6 msec for Cu^{63}, in reasonable agreement with theory. A theory is developed which is applicable only to solids at r-f magnetic field intensities well above the saturation level and which is in reasonable agreement with experimental observations. "Rotary saturation" was observed by applying an a-f magnetic field to the sample in the d-c field direction while observing the dispersion derivative at resonance with a large r-f field. (auth)

5775

SATURATION OF NUCLEAR ELECTRIC QUADRUPOLE ENERGY LEVELS BY ULTRASONIC EXCITATION. W. G. Proctor and W. H. Tanttila (Univ. of Washington, Seattle). Phys. Rev. 98, 1854(1955) June 15.

The decrease in the population difference between the degenerate m = ±1/2 and the m = ±3/2 quadrupole energy levels of Cl^{35} in $NaClO_3$ has been observed following a long pulse of ultrasonic excitation at the transition frequency. The experiment was performed at the temperature of liquid N, for which the transition frequency is 30.63 Mc and the thermal relaxation time is 0.94 sec. Experimental techniques are described. (M.P.G.)

NUCLEAR REACTORS

5776 AECU-3044

Michigan. Univ., Ann Arbor. Engineering Research Inst. STUDY OF THE FEASIBILITY OF AQUEOUS RECOVERY OF SPENT FUELS. PART 3. CALCULATED DISTRIBUTION OF FISSION PRODUCT NUCLIDES. John V. Nehemias, Ralph C. Dennis, and Eugene Ambo. June 1954. 146p.

The mass and the activity of each fission product nuclide present in the spent fuel of a 500-Mw reactor operating on a 42 day cycle, at the time of removal from the reactor and as a function of time thereafter have been calculated and tabulated. The effect of the calculated activities in terms of r/hr at 1 meter from a point source and Btu's/hr of heat generated from β absorption has also been calculated and tabulated. (C.W.H.)

5777

THE HOMOGENEOUS REACTOR EXPERIMENT. A PILOT-MODEL NUCLEAR POWER PLANT. W. R. Gall (Oak Ridge National Lab., Tenn.). Mech. Eng. 77, 575-80(1955) July.

A nuclear pilot plant for the production of electric power with an aqueous solution of uranyl sulfate as fuel has been designed, constructed, and operated by the Oak Ridge National Laboratory over a four-year period. The heat-producing reaction occurred in an 18 in. diam spherical vessel and heat was removed by pumping the liquid fuel through a U-tube heat exchanger where steam was generated for use in a small turbogenerator unit. With the reactor generating 1000 kw of heat at 482 F and 1000 psi, 3000 lb of steam was produced per hr at 200 psia, generating 150 kw of electricity. Designs of major items of equipment and the shield are described and the cost of construction is summarized. (auth)

NUCLEAR TRANSFORMATION

5778 AEC-tr-2183

FISSION OF HEAVY NUCLEI BY HIGH ENERGY NEUTRONS. V. I. Gol'danskii, E. Z. Tarumov, and V. S. Pen'kina. Translated from Doklady Akad. Nauk S.S.S.R. 101, 1027-30 (1955). 10p.

An abstract of this paper appears in Nuclear Science Abstracts as NSA 9-5156.

5779

INVESTIGATION OF THE (γ,p) REACTION ON NICKEL. E. M. Leikin, R. M. Osokina, and B. S. Ratner (Lebedev Physics Inst.). Doklady Akad. Nauk S.S.S.R. 102, 493-4 (1955) May 21. (In Russian)

Energy and angular distributions of protons from Ni irradiated with 21.5-, 25.5-, and 28.0-Mev photons are reported. (G.Y.)

5780

ON THE NUCLEAR INTERACTION OF 350 MEV α-PARTICLES. G. Quareni and G. T. Zorn (Univ. of of Padova, Italy). Nuovo cimento (10) 1, 1282-4(1955) June. (In English)

5781

ON THE EXCITATION FUNCTION OF THE $Ne^{20}(d,p)Ne^{21}$ REACTION. Serge Gorodetzky, Theo Muller, and Marcel Port. Compt. rend. 240, 2224-6(1955) June 6. (In French)

A peak was found in the excitation curve of the $Ne^{20}(d,p)Ne^{21}$ reaction for a deuteron energy E_d = 0.88 Mev. The result is interpreted as an excited state of the compound nucleus Na^{22} at 12.07 Mev. (K.S.)

PARTICLE ACCELERATORS

5782 NP-5700

Kansas. Univ., Lawrence. VAN DE GRAAFF GENERATOR PROJECT FINAL REPORT [FOR] FEBRUARY 1, 1948 TO DECEMBER 31, 1954. (Includes five reprints as Appendices A–E). 50p. Contract ONR-260 TO-2.

Design factors for the generator, both in the old and new laboratories, are discussed. Control circuits, special developments, special difficulties, and operating characteristics are described. Reprints of published research papers resulting from work with the generator are appended. (L.M.T.)

5783 UCRL-2435(Rev.)

California. Univ., Berkeley. Radiation Lab. THE SECOND ELECTRON MODEL PHASE-COMPENSATED C-W CYCLOTRON. Robert Pyle. Mar. 1955. 52p. Contract W-7405-eng-48.

A 40½ in.-diameter constant-frequency cyclotron, an improved version of the model described in UCRL-2344, accelerates electrons to v/c = 0.51. An azimuthal variation in the magnetic field makes the periods of revolution the same in all stable orbits, and provides suitable axial and radial focusing properties. Three 60°-wide wedge-shaped "triants" located at the azimuths of minimum magnetic field, were used as accelerating electrodes. Other constructional and operational details are discussed. (L.M.T.)

5784

THE IMPORTANCE OF HIGH VACUA TO HIGH ENERGY NUCLEAR PHYSICS. L. Riddiford (Univ. of Birmingham, England). Vacuum 3, 231-44(1953) July.

A brief historical account is given of the development of cyclic accelerators, and present and future accelerators are discussed. An attempt is made to show the important place which these machines occupy in a most fundamental field of physics. The dependence of both the machines and the physics upon technology, and in particular high vacuum technique, is emphasised. (auth)

5785

SOME PROTON SYNCHROTRON BEAM STUDIES WITH THE INDUCTION ELECTRODE. L. Riddiford, H. V. van der Raay, and R. F. Coe (Univ. of Birmingham, England). Proc. Phys. Soc. (London) A68, 489-502(1955) June.

The principle of the induction electrode and its application to the detection of the circulating proton beam in the Birmingham synchrotron are discussed. Investigations have been made of the phase width of the bunch of protons being accelerated, and of the period of the phase oscillations. These provide a confirmation of the theory of Bohm and Foldy concerning the acceleration process in a synchrotron. A study of the effects of pressure and aperture on the circulating beam shows that the requirements are more stringent than anticipated from the Blachman–Courant theory of gas scattering in such an accelerator. The difference is explainable in terms of characteristics particular to the Birmingham accelerator. (auth)

5786

CRYSTAL TECHNIQUE FOR MEASURING CYCLOTRON BEAM ENERGIES. Charles J. Delbecq, Warren J. Ramler, Sol R. Rocklin, and Philip H. Yuster (Argonne National Lab., Lemont, Ill.). Rev. Sci. Instr. 26, 543-6(1955) June.

A lithium fluoride crystal when irradiated with deuterons from a cyclotron develops a yellow color; if the deuterons are stopped within the crystal, there is a sharp demarcation in color between the irradiated and unirradiated portions. It has been found that the measurement of the depth of penetration of the color into lithium fluoride can be used to determine accurately (±0.1 Mev at 20 Mev, ±0.2 Mev at 10 Mev) and rapidly the energy of deuterons in a cyclotron beam. A single exposure of a crystal to the deuteron beam allows one to determine not only the energy of the deuterons but also the angular orientation of the beam trajectories. (auth)

5787

BETATRON OSCILLATIONS IN THE SYNCHROTRON. C. L. Hammer, R. W. Pidd, and K. M. Terwilliger (Univ. of Michigan, Ann Arbor). Rev. Sci. Instr. 26, 555-6(1955) June.

Betatron oscillations in the University of Michigan synchrotron have been investigated by exciting these oscillations with a transverse electric field. The results indicate that the betatron oscillation is composed of a group of component frequencies which are separated by the frequency of synchrotron phase oscillation. The suggested explanation of the observed splitting is the modulation of the betatron oscillation frequency by the synchrotron oscillations. (auth)

5788

GENERAL PURPOSE X-BAND LABORATORY MICROTRON WITH FACILITIES FOR ELECTRON EXTRACTION. H. F. Kaiser and W. T. Mayes (Naval Research Lab., Washington, D. C.). Rev. Sci. Instr. 26, 565-7(1955) June.

A 3-Mev X-band microtron (electron cyclotron) particularly suited for laboratory use in nuclear and electron physics is described. About twelve electron orbits, in operating modes representing energy gains per turn up to 255 kev, may be obtained. By means of a magnetic shield probe, electrons may be extracted from any orbit for external experiments. Final orbit currents of 10^{-7} amp and x-ray yields of 0.5 r/min at 10 cm are obtained. Ellipsoidally shaped sealed-off glass microtron tubes are under development. (auth)

RADIATION ABSORPTION AND SCATTERING

5789 NYO-7103

Carnegie Inst. of Tech., Pittsburgh.
THE REACTION $p + p \rightarrow \pi^+ + d$ IN THE 425 MEV REGION. Thomas Henry Fields. Feb. 22, 1955. 77p. Contract AT(30-1)-882.

The 437-Mev external proton beam of the Carnegie Institute of Technology synchrocyclotron has been used to measure the angular distribution and total cross section of the reaction $p + p \rightarrow \pi^+ + d$. The proton beam impinged upon liquid hydrogen, and the resulting positive pions were detected in fast coincidence with their associated deuterons. The differential cross section was measured at seven pion center of mass angles in the range from 30° to 130°. Several corrections were applied to the observed counting rates, including a downward correction of about 7% to compensate for coincidence counts which arose from the reaction $p + p \rightarrow \pi^+ + p + n$. The corrected total cross section for the reaction $p + p \rightarrow \pi^+ + d$ is 1.23 ± 0.07 mb. with a center of mass angular distribution proportional to $(0.23 \pm 0.02) + \cos^2\theta$. In addition, a 45% polarized proton beam of energy about 415 Mev was used to measure azimuthal asymmetries in the $p + p \rightarrow \pi^+ + d$ reaction. The experimental technique was very similar to that used for the production cross section measurements. The asymmetry ϵ, defined as the difference divided by the sum of the pion intensities on the right and left, was measured at pion center of mass angles of 90° and 50°. The magnitude of the measured asymmetries were $\epsilon(90°) = .20 \pm .03$ and $\epsilon(15°) = 0.023 \pm 0.015$ in such a sense that the greatest meson intensity was on the left with the polarized beam originating in a scattering to the right. The results of the cross section and asymmetry measurements are discussed in relation to recent analyses of the threshold behavior of the $p + p \rightarrow \pi^+ + d$ and other meson production reactions. (auth)

5790 ORNL-1910

Oak Ridge National Lab., Tenn.
DISCRETE ELECTRON ENERGY LOSSES IN THIN METALLIC FOILS. A. W. Blackstock. July 8, 1955. 146p. Contract W-7405-eng-26.

A study was made of discrete energy losses suffered by electrons with primary energies in the range 25 to 115 kev which are scattered through angles less than one degree in passing through thin foils of Al, Mg, Cu, and Ag. The measurements were made with an electron accelerator and an energy analyzer of very high resolution resulting from the use of a stopping-potential-type energy analyzer together with a low-energy cylindrical electrostatic analyzer. The mean free paths, cross sections and stopping powers, as a function of incident electron energy, corresponding to these discrete losses have been calculated for Al, Mg, and Cu. The results are compared with previous experimental measurements and with the "plasma oscillation" theory of Pines and Bohm (Phys. Rev. 85, 338(1952)). (auth)

5791

THE SCATTERING OF SLOW NEUTRONS BY ORTHO- AND PARA-HYDROGEN. G. L. Squires and A. T. Stewart (Univ. of Cambridge, England). Proc. Roy. Soc. (London) A230, 19-32(1955) June 7.

The neutron velocity selector of the Cavendish Laboratory has been used to measure the scattering cross-sections of ortho- and para-hydrogen for slow neutrons. The triplet and singlet scattering amplitudes of the neutron-proton interaction may be deduced from these cross-sections. The values obtained are $a_t = (0{\cdot}537 \pm 0{\cdot}004) \times 10^{-12}$ cm, and $a_s = -(2{\cdot}373 \pm 0{\cdot}007) \times 10^{-12}$cm, where a_t and a_s are the triplet and singlet scattering amplitudes respectively. The values of the coherent, scattering amplitude $f = 2(^3/_4a_t + ^1/_4a_s)$, and of the free proton cross-section $\sigma_f = 4\pi(^3/_4a^2 + ^1/_4a_s^2)$ given by the above values of a_t and a_s, are $f = -(0{\cdot}380 \pm 0{\cdot}005) \times 10^{-12}$ cm, and $\sigma_f = (20{\cdot}41 \pm 0{\cdot}14) \times 10^{-24}$ cm^2. (auth)

5792

THE INELASTIC SCATTERING OF NEUTRONS BY MAG-

NETIC SPIN WAVES. R. J. Elliott and R. D. Lowde (Atomic Energy Research Establishment, Harwell, Berks, England). Proc. Roy. Soc. (London) A230, 46-73(1955) June 7.

The inelastic scattering of neutrons by ferromagnetic and antiferromagnetic crystals is considered on spin-wave theory, using the formalism of Holstein & Primakoff. The influence of dipole-dipole interaction and of an applied magnetic field is examined in detail for ferromagnetic crystals. Scattered intensity distributions and total cross-sections are derived in terms of the angular setting of the crystal; they are valid at temperatures low compared with the relevant critical temperatures. The spin-wave interaction leads to magnetic diffuse reflexion of neutrons from the crystal planes, closely analogous to the phonon diffuse reflexion of neutrons and x rays. These reflexions become intense near the positions for magnetic Bragg scattering; with antiferromagnetic crystals there is an additional set of feeble diffuse reflexions near the directions of nuclear Bragg scattering. The spin-wave diffuse reflexions are always superposed on phonon reflexions. However, in antiferromagnetics the nuclear and magnetic parts of phonon scattering are separated, so that the principal spin-wave reflexions fall on the magnetic part only. Anisotropy forces affect the intensity only for settings very near the Bragg angle. The phenomenon is capable of giving very direct information on the low-lying energy states of magnetic crystals. Cross sections, however, are of the order of millibarns and detailed consideration is given to the problem of their experimental isolation. (auth)

5793

THE ANGULAR DISTRIBUTION OF MULTIPLY-SCATTERED γ-RADIATION. B. W. Soole (Admiralty Research Lab., Teddington, Middlesex, England). Proc. Roy. Soc. (London) A230, 343-53(1955) June 21.

The intensity of ionization up to a distance of 400 yards ($2\frac{1}{2}$ m.f.p.) in air from a forward-emitting 500-c source of Co^{60} has been measured using air-filled condenser integrating ion chambers with air equivalent walls. These chambers have been used unshielded, and also shielded by lead cones cutting off all radiation within ±5° of the main beam and within increasing angles up to ±90°. It has been found that of the total, unshielded dose, 25% is due to scattered radiation arriving over angles outside ±5° of the main beam at 100 yards, with a corresponding figure of 52% at 400 yards. Back-scattered radiation accounts for 5% of the dose at 100 yards and 10% at 400 yards. Figures for intermediate angles and distances are also given. It appears possible that equilibrium is reached at about 600 yards (4 m.f.p.) with values only slightly above those quoted for 400 yards. (auth)

5794

CROSS SECTIONS FOR 2s—2p TRANSITIONS IN H AND 3s—3p TRANSITIONS IN Na PRODUCED BY ELECTRON AND BY PROTON IMPACT. M. J. Seaton (Univ. Coll., London). Proc. Phys. Soc. (London) A68, 457-73(1955) June.

Reliable cross sections for 2s—2p transitions in H produced by electron and by proton impact are required in certain astrophysical problems. In calculating these cross sections it is necessary to allow for strong coupling effects. Such effects are also important for 3s—3p transitions in Na produced by electron impact, for which experimental results are available. The total cross section Q is the sum of components Q^l arising from the components of the incident wave with angular momenta $\hbar[l(l+1)]^{1/2}$. For these a limiting value Q^l_{max} is set by the requirement of charge conservation. The approximation adopted is to calculate the Q^l using the Bethe approximation, to accept the values obtained if $Q^l_{Bethe} < \frac{1}{2} Q^l_{max}$ and to put $Q^l = \frac{1}{2} Q^l_{max}$ if $Q^l_{Bethe} \geq \frac{1}{2} Q^l_{max}$. The conditions for the validity of this approximation are examined, some use being made of an exactly soluble schematic model. It is considered that the final results for the H transitions should be correct to within ±20%. The results obtained for electron collisions with Na are found to be in good agreement with experiment, the approximation used being considerably superior to the Born approximation at low energies. (auth)

5795

FORM FACTORS FOR INCOHERENT SCATTERING OF HIGH ENERGY CHARGED PARTICLES BY NUCLEI. V. Benzi (Univ. of Cagliari, Italy). Nuovo cimento (10) 1, 1261-3(1955) June.

Simple closed expressions are derived for the form factors for incoherent electromagnetic scattering of high-energy electrons or mesons by nuclei with $Z \leq 20$. (K.S.)

5796

ON ANGULAR EFFECTS IN NUCLEAR REACTIONS INDUCED BY UNPOLARIZED PARTICLES. Chr. D. Hartogh, S. R. De Groot, and H. A. Tolhoek (Univ. of Leiden, Netherlands). Physica 21, 281-4(1955) Apr. (In English)

Explicit formulas are given for the angular distribution and angular correlation of radiation (particles or polarized γ-radiation) emitted by nuclei, which are formed by the capture of unpolarized particles by initial nuclei oriented at random. (auth)

5797

MEASUREMENT OF IONIZATION IN NUCLEAR EMULSIONS. P. H. Fowler and D. H. Perkins (Univ. of Bristol, England). Phil. Mag. (7) 46, 587-610(1955) June.

The gap-length distribution along the tracks of ionizing particles in nuclear emulsions has been investigated, and shown to be exponential for all values of specific ionization. The coefficient of the exponential, g, is suggested as the most useful measure of the ionization. In the first part of the paper, practical visual methods of measuring g are discussed. Accuracies not far inferior to the maximum possible are obtained by counting the small proportion of gaps of lengths exceeding two or three times the average value. The ratio of the coefficient g in a given track, to that in the track of a relativistic electron, is shown to be independent of degree of development, for particles below six times plateau ionization. In the second part of the paper, a detailed model is proposed, which is capable of explaining the dependence of g on the velocity and charge of the ionizing particle, and on the development and sensitivity of the emulsion. (auth)

5798

THE MULTIPLE SCATTERING OF POSITRONS AND ELECTRONS BY NITROGEN AND ARGON. N. Cusack and P. Scott (Birkbeck Coll., London). Phil. Mag. (7) 46, 632-9(1955) June.

A combination of lens spectrometer and cloud chamber was used to measure and compare the multiple scattering of positrons and electrons at energies in the neighborhood of 0·4 Mev. The ratio of observed to theoretical mean absolute scattering angle was 0·99 for N_2 and 0·92 for A, with a standard error of 3%. Comparable results by other workers are discussed. In contrast with the conclusions of other workers, no significant difference in the behavior of positrons and electrons could be detected. (auth)

5799

THE PRODUCTION OF NEUTRONS AND PROTONS BY THE BOMBARDMENT OF BORON BY LOW ENERGY ALPHA-PARTICLES. E. S. Shire and R. D. Edge (Cavendish Lab., Cambridge, England). Phil. Mag. (7) 46, 640-51(1955) June.

The numbers of neutrons and protons produced in the reactions $B^{10}(\alpha n)N^{13}$ and $B^{10}(\alpha p)C^{13}$ at 1·51 Mev bombarding energy have been compared and the ratio of the reduced widths, γ_n^2/γ_p^2, found to be 5·7 ± 0·5. Between 1·4 and 2·4 Mev bombarding energy, the emission of protons is closely similar to that of neutrons, but γ_n^2/γ_p^2 has fallen to a value nearer unity at a resonance at 2·16 Mev. The resonance previously reported when B^{11} is bombarded by alpha-particles of 1·58 Mev energy has been shown to be a doublet and a further resonance for neutron emission, but not proton emission, has been found at 2·05 Mev. (auth)

5800

THE NUCLEAR INTERACTIONS PRODUCED IN CARBON, NITROGEN AND OXYGEN BY 140 MEV PROTONS. H. Muirhead and W. G. V. Rosser (Univ. of Glasgow, Scotland). Phil. Mag. (7) 46, 657-62(1955) June.

A comparison is made between the nuclear disintegrations produced in carbon, nitrogen and oxygen by 140-Mev protons, and the nature of the disintegrations expected from the Goldberger model (1948). (auth)

5801

THE BOMBARDMENT OF CHLORINE BY NITROGEN IONS. G. W. Greenlees and A. E. Souch (Univ. of Birmingham, England). Phil. Mag. (7) 46, 682-4(1955) June.

A cyclotron N ion beam was used to bombard a Li Cl target. Relative yields of resultant activities are tabulated. Two possible mechanisms are suggested to account for the yields. (B.J.H.)

5802

DIFFERENTIAL CROSS-SECTION MEASUREMENTS FOR LARGE-ANGLE COLLISIONS OF HELIUM, NEON, AND ARGON IONS WITH ARGON ATOMS AT ENERGIES TO 100 KEV. Edgar Everhart, R. J. Carbone, and Gerald Stone (Univ. of Conneticut, Storrs). Phys. Rev. 98, 1045-9 (1955) May 15.

The differential cross section for the scattering of positive charge from collisions of noble gas ions with the target gas argon has been measured. The ion beam is passed through a chamber containing the target gas at a pressure of a few microns of mercury, which is low enough to insure that single collisions will predominate. The particles scattered out of the beam are collected and the total positive charge is measured. The collector incorporates collimating holes to select only those particles at a chosen scattering angle with a resolution of about two degrees. The apparatus allows the angle to be varied continuously up to 38°. Data are presented for collisions of singly ionized helium, neon, and argon ions with argon atoms at 25, 50, and 100 kev. The cross sections observed differ from those expected from the Rutherford scattering law and these differences are interpreted in terms of electron screening, ionization, and charge exchange. (auth)

5803

ENERGY LOSS BY 8.86-MEV DEUTERONS AND 4.43-MEV PROTONS. J. E. Brolley, Jr. and F. L. Ribe (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. 98, 1112-17(1955) May 15.

Using deuterons of average energy 8.86 Mev, the stopping powers relative to air have been measured for the following gases: H_2, He, N_2, O_2, Ne, A, Kr, Xe, CH_4, and CO_2. Absolute stopping cross sections were measured, using 4.43-Mev protons (of equal velocity) for H_2, air, and Kr, and the deuteron results were normalized to give absolute stopping cross sections for all of the gases. Comparison is made with the theoretical results of Aron et al., Walske, and Lindhard and Scharff. It was found that the NaI(Tl) crystal exhibited a nonlinearity in its response curve of light output versus proton or deuteron energy. (auth)

5804

THEORY OF ELECTRON PENETRATION. L. V. Spencer (National Bureau of Standards, Washington, D. C.). Phys. Rev. 98, 1597-1615(1955) June 15.

The theory of electron penetration in an infinite medium under the combined influence of scattering and slowing down is developed to the point of numerical application. Sample calculations of energy dissipation vs. distance from the source are compared with experiments by Frantz, by Clark, Brar, and Marinelli, and by Loevinger. The agreement is good provided that relativistic scattering cross sections are used. The energy loss is treated in the continuous slowing down approximation; the resulting error is appreciable only at extreme penetrations. (auth)

5805

MULTIPLE SCATTERING OF SLOW NEUTRONS BY FLAT SPECIMENS AND MAGNETIC SCATTERING BY ZINC FERRITE. B. N. Brockhouse (Atomic Energy of Canada Ltd., Chalk River) and L. M. Corliss and J. M. Hastings (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 98, 1721-7(1955) June 15.

Measurements of scattering from Be, Pb, Bi, and Th under conditions where multiple scattering predominated were compared with predictions based on the work of Chandrasekhar and of Vineyard. Good agreement was obtained. A table of values of the expected multiple scattering by flat specimens is given. These results were used to correct measurements of diffuse scattering by zinc ferrite at room temperature and higher to obtain the differential magnetic cross section of the magnetic ions. The cross section shows interesting features which are discussed. At liquid nitrogen temperatures a small-angle scattering effect was found. This is interpreted as arising from short-range ferromagnetic ordering of the iron ions. (auth)

5806

DIRECT MEASUREMENT OF THE EFFECT OF POLARIZATION ON ENERGY LOSS. E. L. Goldwasser, F. E. Mills, and T. R. Robillard (Univ. of Illinois, Urbana). Phys. Rev. 98, 1763-5(1955) June 15.

The energy losses suffered by 15.7-Mev electrons in traversing samples of about one gram per cm^2 of absorber in gas and solid form have been measured. Two pairs of absorbers have been used; perfluorocyclobutane gas and its polymer, tetrafluoroethylene resin, "Teflon", and chlorotrifluoroethylene gas and its polymer, "Kel-F" plastic. The losses measured were of the order of one Mev and the resolution of the apparatus made possible an accuracy of 20 kev. The measured losses compared with theoretical predictions are as follows: Teflon—gas 1.33 Mev by experiment and 1.33 Mev by theory, solid 1.27 Mev by experiment and 1.24 Mev by theory; Kel-F—gas 1.29 Mev by experiment and 1.33

Mev by theory, solid 1.09 Mev by experiment and 1.11 by theory. (auth)

5807

CHARGE DISTRIBUTIONS OF OXYGEN AND NEON IONS PASSING THROUGH GASES. Edward L. Hubbard and Eugene J. Lauer (Univ. of California, Berkeley). Phys. Rev. 98, 1814-17(1955) June 15.

Electrons were stripped from accelerated oxygen and neon ions by passing them through a gas. Magnetic deflection was used to select the energy and charge of the incident ions and to determine the distribution of ionic charges in the stripped beam. As the amount of gas that the ions passed through was increased, the peak of the charge distributions first shifted toward higher charge states and then became constant as equilibrium was established between capture and loss of electrons. At equilibrium in argon the charge distributions were bell-shaped, with a width of 1.8 charge states at half maximum. The average ionic charges for 3.3-, 6.1-, and 8.7-Mev O ions were 3.5, 4.8, and 5.2, respectively, and for 3.1-, 7.1-, and 10.3-Mev Ne ions 3.3, 4.9, and 6.0, respectively. (auth)

5808

ELECTRON CAPTURE AND LOSS BY IONS IN GASES. Robert L. Gluckstern (Yale Univ., New Haven) Phys. Rev. 98, 1817-21(1955) June 15.

Capture and loss cross sections for ions of intermediate atomic number (Z_1 = 8 to 18) passing through low-pressure gases have been calculated. A modified form of Bell's model was used, leading to lower capture cross sections than the original model. The resulting equilibrium charge distributions obtained compare favorably with the experimental results of Hubbard and Lauer. The individual cross sections were obtained from the observed dependence of the charge distribution on the stripper thickness; these results agree reasonably well with the predictions of the calculations. Capture and loss of two electrons in a single collision may be significant, but the effect on the charge distributions should not be too great. (auth)

5809

CROSS SECTION FOR ELECTRON CAPTURE AND LOSS BY 26-MEV NITROGEN IONS. H. L. Reynolds, L. D. Wyly, and A. Zucker (Oak Ridge National Lab., Tenn.). Phys. Rev. 98, 1825-7(1955) June 15.

Electron capture and loss cross sections were measured for 26-Mev nitrogen ions in Zapon. Charge groups, separated by the fringing magnetic field of the cyclotron, were passed through Zapon foils sufficiently thin so that charge equilibrium was not achieved. The relative intensities of the nonequilibrium charge distributions were analyzed to determine the ratios of the cross sections. It was found that $\sigma_{56}/\sigma_{67} = 2.6$, $\sigma_{56}/\sigma_{65} = 3.8$, and $\sigma_{67}/\sigma_{76} = 0.78$. If it is assumed that the average atom in Zapon has a mass of 14, the cross sections for electron capture and loss for 26-Mev nitrogen ions are, in cm^2/atom: $\sigma_{56} = 7.6 \times 10^{-18}$, $\sigma_{65} = 2.0 \times 10^{-18}$, $\sigma_{67} = 2.9 \times 10^{-18}$, $\sigma_{76} = 3.8 \times 10^{-18}$. Nonequilibrium charge distributions as a function of foil thickness are given for initial beams consisting entirely of any one of the ion groups N^{7+}, N^{6+}, or N^{5+}. (auth)

5810

MEASUREMENT OF ABSORPTION COEFFICIENTS FOR PHOTOIONIZING RADIATIONS IN LOW-PRESSURE GASES WITH A SPACE CHARGE DETECTOR. C. D. Maunsell (Univ. of California, Berkeley). Phys. Rev. 98, 1831-6(1955) June 15.

A Kingdon cage space-charge detector has been used to measure the production of positive ions in a low-pressure gas due to absorption of photons produced by electron impact excitation in another region of the same gas. Absorption coefficients were measured by changing the source to detector separation. High-purity vacuum techniques were used to avoid contamination of the gas. No ionization was found in hydrogen. For nitrogen the molecular cross section was 4.1×10^{-16} cm^2 and for argon the atomic cross section was 3.1×10^{-16} cm^2. Tentative suggestions are made as to the processes responsible for these total absorption cross sections being much larger than the photoionization cross sections for monochromatic radiations in the ionization continuum region. (auth)

RADIATION EFFECTS

5811

PHOTOELASTIC OBSERVATIONS OF THE EXPANSION OF ALKALI HALIDES ON IRRADIATION. W. Primak, C. J. Delbecq, and P. H. Yuster (Argonne National Lab., Lemont, Ill.). Phys. Rev. 98, 1708-14(1955) June 15.

Alkali halide crystals subjected to a nonuniform irradiation by x rays or high-energy deuterons are found to become anomalously birefringent. The effect has been studied in detail in lithium fluoride. It is shown that the birefringence is due to the photoelastic effect accompanying a nonuniform dilatation which is calculated from the measured birefringence with the aid of elasticity theory. The crystals are colored as a result of the irradiation; and from the absorption coefficients, the number of color centers per unit volume is calculated. It is found that the volume of vacancies per unit volume is approximately equal to the dilatation. A possible explanation for this result is that the vacancies associated with the color centers are generated at the jogs of edge dislocations during irradiation. (auth)

5812

FAST-NEUTRON BOMBARDMENT OF n-TYPE Ge. J. W. Cleland, J. H. Crawford, Jr., and J. C. Pigg (Oak Ridge National Lab., Tenn.). Phys. Rev. 98, 1742-50(1955) June 15.

The effect of fast-neutron bombardment on the electrical properties of n-type Ge has been extensively studied by a variety of experiments. The initial rate of carrier removal, the shape of the bombardment curve, and the temperature dependence of electron concentration in bombarded specimens all indicate the production of two vacant states, one located below the middle of the forbidden energy band and the other located ~0.2 ev below the conduction band. These two vacant states are consistent with predictions of the model of James and Lark-Horovitz. Studies of mobility reveal that the additional scattering associated with bombardment-induced lattice disorder is more complex than charged impurity scattering in that it exhibits a much greater temperature dependence and is markedly dependent on electron concentration. Low-temperature exposure and subsequent warming experiments indicate that appreciable photoconductivity associated with minority-carrier trapping results from fast-neutron bombardment. The important minority-carrier traps appear to anneal during warming below room-temperature. (auth)

5813

EXPERIMENTAL EVIDENCE FOR THERMAL SPIKES IN RADIATION DAMAGE. W. Primak (Argonne National Lab., Lemont, Ill.). Phys. Rev. 98, 1854-5(1955) June 15.

A brief review is given of experiments that have been performed related to establishing the mechanism of thermal spikes in radiation damage. No definite conclusions are reached. (B.J.H.)

RADIOACTIVITY

5814 AD-30109

Fordham Univ., New York.

BETA RAY IONIZATION INTENSITY OF POTASSIUM, URANIUM AND THORIUM. SCIENTIFIC REPORT NO. 3. V. F. Hess, R. I. Weller, and W. D. Parkinson. Dec. 1953. 60p. Contract AF19(122)-409.

The absolute intensity of β-ray ionization from naturally radioactive K and U and Th ores was investigated. A flat ionization chamber connected to a Lindemann-Ryerson electrometer was used as the measuring instrument. A compressed-air cylinder which permitted Rn-free air to flow through a reduction valve and pressure gage was incorporated; the Rn-free air then flowed through a calibrated flowmeter and into the ionization chamber. Local γ-radiation effects were reduced by placing the entire apparatus in an iron house. The use of extended thick sources with a flat rectangular ionization chamber appeared feasible. Absorption measurements made on the β radiation from K were consistent and are corroborated by previous results of other investigators. For the K β rays, Eve's constant divided by the mass absorption coefficient was 33 ± 2 ion pairs/cc/sec. For U ore in equilibrium with its decay products, Eve's constant divided by the mass absorption coefficient equaled 53,200 ± 3200 ion pairs/cc/sec; for Th ore in equilibrium, 13,200 ± 800 ion pairs/cc/sec. (ASTIA Abst.)

5815 BNL-340

Brookhaven National Lab., Upton, N. Y.

CHLORINE-36 IN NATURE. Raymond Davis, Jr. and Oliver A. Schaeffer. June 1955. 16p.

The 308,000-year half life chlorine isotope, Cl^{36}, has been detected in nature. Estimations are made of the amounts of Cl^{36} radioactivity induced by cosmic-ray neutrons and neutrons from small amounts of uranium in surface rocks and various saline waters. It is shown that cosmic-ray neutrons should induce measurable amounts of activity in certain surface rocks containing chlorine. Measurements were made by low level counting techniques on chlorine isolated from four natural sources: a phonolite rock from Cripple Creek in Colorado, a syenite rock from Red Hill in New Hampshire, Great Salt Lake water, and Atlantic Ocean water. The phonolite contained (0.12 ± .02) disintegrations per minute per gram of chlorine, and the other samples contained less activity than the minimum detectable with the counter used. Calculations show that the activity observed in the phonolite arises from cosmic-ray neutrons. A discussion is given of the possibility of employing the rate of growth of Cl^{36} in surface rocks as a means of establishing a time scale for geological events in the range of 4000 to 1,000,000 years ago. (auth)

5816

THE RADIOACTIVITY OF ^{183}Ta, ^{185}Ta, ^{183m}W AND ^{185m}W. A. J. Poë (Atomic Energy Research Establishment, Harwell, Berks, England). Phil. Mag. (7) 46, 611-20(1955) June.

The following radiation characteristics of the neutron excess tantalum isotopes Ta^{183} and Ta^{185} and of the isomers W^{183m} and W^{185m} have been determined:

	Ta^{183}	Ta^{185}	W^{183m}	W^{185m}
Half life	5·0 ± 0·1 days	49·5 ± 1·5 min	5·5 sec	1·62 ± 0·05 min
β energy (Mev)	~0·15, 0·6	~0·15, 1·72		
γ energy (kev)	110, 160, 210, 240, 320	125, 175, 235	105, 155	130, 165

Ta^{185} does not decay to any appreciable extent via the isomer W^{185m} and the 175-kev γ from Ta^{185} is not the same as the 165-kev γ from W^{185m}. The 125-kev γ from Ta^{185} and the 130-kev γ from W^{185m} are probably the same and due to transition to the ground state of W^{185}. Unless there is an undetected rate-determining transition the 165-kev γ from W^{185m} is then due to the isomeric transition and from half life and K conversion considerations it may be classified as E3. Similarly the 155-kev γ in W^{183m} is probably from the rate-determining transition. The classification of the W^{183m} isomeric transition type on the basis of K conversion measurements is not unambiguous. (auth)

5817

POSITRONS FROM ^{25}Al AND ^{26m}Al. B. Elbek, B. S. Madsen, and O. Nathan (Univ. of Copenhagen, Denmark). Phil. Mag. (7) 46, 663-9(1955) June.

The positron emitters 7·4 sec Al^{25} and 6·6 sec Al^{26m} have been produced by proton capture in Mg^{24} and Mg^{25}. Their subsequent decays have been investigated by means of a magnetic lens spectrometer. The maximum energies were measured as 3·24 ± 0·03 Mev for Al^{25} and 3·21 ± 0·03 Mev for Al^{26m}. The spectra show no complexities and yield straight Fermi plots down to about 1300 kev. The deviations from linearity at lower energies are probably due to scattering in the spectrometer. No γ rays except annihilation radiation was found. (auth)

5818

STATIC MAGNETIC FIELD QUENCHING OF THE ORTHO-POSITRONIUM DECAY: ANGULAR DISTRIBUTION EFFECT. V. W. Hughes, S. Marder, and C. S. Wu (Columbia Univ., New York). Phys. Rev. 98, 1840-8(1955) June 15.

An effect of the angular dependence of the annihilation radiation from the magnetic substates of orthopositronium has been observed in an experiment similar to that of Deutsch and Dulit. Quanta due to positron annihilations were observed at a direction of 90° to a magnetic field. The fraction, f, of orthopositronium decaying by three-quantum annihilation can then be computed, and at high values of the field f was found to be less than $^{2}/_{3}$. The value $^{2}/_{3}$ is expected statistically since only annihilation radiation of the M = 0 substate is affected by the field. Our observation is understandable if Drisko's formulas for the angular distribution of the annihilation radiation from the different magnetic substates are considered. The ratio of the dacay rates of parapositronium to orthopositronium can be computed from values of f vs the field, after corrections are made for the angular distribution of the quanta. Our date yield $\lambda_p/\lambda_o = 1302$ with a probable error of ±15%, in agreement with the theoretical value of 1114. (auth)

5819

BETA-ALPHA ANGULAR CORRELATION OF Li^{8}. Masato Morita (Kobayasi Inst. of Physical Research, Tokyo) and Masami Yamada (Univ. of Tokyo). Progr. Theoret. Phys. (Japan) 13, 114-15(1955) Jan.

It is shown that some angular correlation may exist between the successive decays of Li^8 and Be^8 even if the Li^8 β decay is allowed. (B.J.H.)

SPECTROSCOPY

5820

EFFECTS OF ELECTRON COLLISIONS ON THE WIDTH OF SPECTRAL LINES. Henry Margenau (Yale Univ., New Haven) and Bennett Kivel (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. 98, 1822-4(1955) June 15.

The conditions under which the charges of a plasma take on particle characteristics and can be treated by classical mechanics are stated in terms of the half-width of the thermodynamic wave packet. A simple derivation is given for the quantity γu defined in a previous paper (the line width resulting in the absence of degeneracy), which shows the formula there developed to be correct for large γu. This removes the earlier restrictions. (auth)

THEORETICAL PHYSICS

5821

ON THE UNIVERSALITY OF THE WEAK BOSON-FERMION INTERACTION. Kenzo Iwata, Shuzo Ogawa, Hisaichiro Okonogi, Bunji Sakita, and Sadao Oneda (Nagoya Univ. and Kanazawa Univ., Japan). Progr. Theoret. Phys. (Japan) 13, 19-37(1955) Jan.

With the aim to investigate the possibility of reducing the complicated interactions between various sorts of elementary particles to some kind of interactions which have certain primary and universal character, analysis is made on the weak interactions between bosons and fermions which appear in the recent high-energy experiments. It is suggested that there might exist one type of interaction which seems to have desired property. (auth)

5822

INTERMEDIATE COUPLING MESON THEORY OF NUCLEAR FORCES. I. GENERAL FORMULATION. Hiroichi Hasegawa (Osaka City Univ., Japan). Progr. Theoret. Phys. (Japan) 13, 47-61(1955) Jan.

The method of construction of nuclear potential is represented in charged scalar meson theory as example, assuming that (i) the kinetic energies of the nucleons are not very large, and (ii) interaction between nucleons and meson field is not very strong. Starting with the single clothed nucleons, we restrict the number of mesons exchanged between the nucleons up to two. This corresponds to the expansion of the nuclear potential into the power of $\exp(-\mu r)$. The assumption (i) guarantees this procedure. The potential of order of $\exp(-\mu r)$ differs from the conventional one by the factor $(1 - P_d)^2$ which is due to the dissociation probability P_d of the single clothed nucleon. The potential of order of $\exp(-2\mu r)$ originates from the effects: (i) distortion of zero-meson fields, (ii) transition to the isobaric states, (iii) emission and absorption of s-mesons by the individual particles. The exchange of the s-meson cannot occur, so far as we are concerned with the potentials up to the order of $\exp(-2\mu r)$. This suggests that the zero-mesons described by intermediate coupling meson theory would give the good picture of the meson cloud around the nucleons, for the low energy nuclear forces. (auth)

5823

DERIVATION OF THE VALUE OF THE COUPLING CONSTANT g FROM THE REST ENERGY OF THE NUCLEON. Ferdinand Cap (Innsbruck Univ., Australia). Progr. Theoret. Phys. (Japan) 13, 62-8(1955) Jan.

The static interaction energy between two nucleons and the value of the coupling constant g are derived from a unitary nonlinear charge symmetrical pseudoscalar meson theory that contains no free parameters. (auth)

5824

THE PROPERTIES OF THE MESON THEORETICAL POTENTIALS IN Li^6. Shoichiro Otsuki, Tatsuro Sawada, and Syota Suekane (Kyoto Univ., Japan). Progr. Theoret. Phys. (Japan) 13. 79-92(1955) Jan.

To study the properties of the symmetrical pseudoscalar meson theoretical potentials in nuclei, we apply them to Li^6 that is expected to disclose the properties of two-body forces in nuclei as directly as possible and investigate how favourable these potentials are to the static properties of Li^6. The potentials between two nucleons are divided into two regions at 0.6 times the meson Compton wave length. The outside potentials are derived from the symmetrical pseudoscalar meson theory, while the inside potentials are determined from nucleon-nucleon scattering experiments phenomenologically. The excitation energies of the levels and the nuclear moments are calculated according to the intermediate coupling method. The meson theoretical potentials are very favourable to Li^6 without any modification, though the contribution from the potentials of the inside region is large. The order and spacing of the levels and spins are reproduced correctly up to the 3rd excited state. The corresponding spin-orbit coupling strength is large, namely, 8 to 12 Mev, and can also explain the nuclear moments in the same region, so it is rather close to the jj-coupling limit than the LS-coupling limit. The tensor force does not affect the results essentially. (auth)

5825

A NOTE ON THE DAMPING OF PAIR FORMATION IN PSEUDOSCALAR MESON THEORY. Tetuo Hamada and Yoshiyuki Shono (Hokkaido Univ., Japan). Progr. Theoret. Phys. (Japan) 13, 102-3(1955) Jan.

Radiative corrections to the nucleon preparation function have been calculated and from this, possible damping effects on nucleon pair formation have been calculated. It is concluded that one cannot assume damping effects to occur. (B.J.H.)

5826

RECOIL CORRECTION TO THE ADIABATIC NUCLEAR POTENTIAL. Mitsuo Shindo and Kazuhiko Nishijima (Kyoto Univ. and Osaka City Univ., Japan). Progr. Theoret. Phys. (Japan) 13, 103-5(1955) Jan.

A theoretical discussion is given of the case where a meson cloud around a fixed source nucleus may be deformed when the nucleons are put in motion. In this case, an adiabatic approximation to the exact Schrödinger equation is used. A recoil correction is also made and the validity of the approximation is shown. (B.J.H.)

5827

ON THE EQUIVALENCE THEOREM. Yasushi Takahashi (National Research Council, Ottawa, Canada). Progr. Theoret. Phys. (Japan) 13, 105-6(1955) Jan.

A theoretical discussion is given on the non-gauge term in the $\pi^0 \rightarrow 2\gamma$ process which contradicts the Equivalence Theorem. It is concluded that this term may be cancelled in the same way as the term which violates gauge invariance. Calculations are given. (B.J.H.)

5828

MATRIX ELEMENTS OF β-DECAY FOR A SPHEROIDAL CORE MODEL. Morikazu Nomoto (Niigata Univ., Japan). Progr. Theoret. Phys. (Japan) 13, 117-19(1955) Jan.

A discussion is given of a nuclear model in which the nucleus is made up of a constantly deformed spheroidal core and a single particle which moves in the core field. The Hamiltonian of the system is discussed. Matrix elements for allowed and forbidden transitions are given. (B.J.H.)

5829

GENERAL PURTURBATION THEORY IN NEUTRONICS. E. D. Pendlebury (Atomic Weapons Research Establishment, Aldermaston, Berks, England). Proc. Phys. Soc. (London) A68, 474-81(1955) June.

A general approach to perturbation theory in neutronics is given, and particular cases of one and two energy groups are considered. A method is also suggested for the treatment of large perturbations. (auth)

5830

ON POINT INTERACTION IN QUANTUM ELECTRODYNAMICS. L. Landau and I. Pomeranchuk. Doklady Akad. Nauk S.S.S.R. 102, 489-92(1955) May 21. (In Russian)

5831

NON-LINEAR INTERACTIONS AND NUCLEAR SATURATION. E. Clementel and C. Villi (Univ. of Padova, Italy and Univ. of Trieste, Italy). Nuovo cimento (10) 1, 1273-6(1955) June.

URANIUM AND URANIUM COMPOUNDS

5832

A CALORIMETRIC DETERMINATION OF THE AVERAGE KINETIC ENERGY OF THE FRAGMENTS FROM U^{235} FISSION. R. B. Leachman and W. D. Schafer (Los Alamos Scientific Lab., N. Mex.). Can. J. Phys. 33, 357-63(1955) July.

The average heat of thermal-neutron induced fission of U^{235} has been measured by a differential calorimeter. The average energy per fission observed by the calorimeter was 170.1 ± 1.2 Mev. On the basis of the thicknesses of the calorimeter materials and the theoretical energy loss equation, the β energy per fission observed by the calorimeter is 3.0 ± 1 Mev and, on the same basis, the γ and neutron energy observed is negligible. The resulting 167.1 ± 1.6 Mev for the average kinetic energy of the fission products is shown to be in good agreement with less direct determinations of this quantity. (auth)